

POPULAR SCIENCE

DECEMBER
15 CENTS

20 CENTS IN CANADA

FOUNDED MONTHLY 1872

NOW
15¢



SEE PAGE 49



NEW INVENTIONS • MECHANICS • MONEY MAKING IDEAS
HOME WORKSHOP PLANS AND HINTS • 350 PICTURES

The Boy who Discovered the \$1150.00 Candle

Have you ever seen a candle that burns with a blue flame? Probably not. Few people have. . . . Then 15-year-old Dennis Collins—experimenting with his Gilbert Chemistry Outfit—perfected a process that startled the scientific world. Read Dennis' own story of his thrilling achievement.

HOW DENNIS COLLINS WON FAME AND A BIG AWARD WITH HIS GILBERT CHEMISTRY OUTFIT



"I have always wanted to be a chemist, and when my Dad gave me a Gilbert Chemistry Outfit, I was the happiest boy alive. I knew Mr. Gilbert made the finest chemistry sets in the world—and a boy can't be a good chemist unless he has good chemicals."

"Every day I made new discoveries. I learned how to make invisible ink—how to change water into milk. One afternoon I took some of my chemicals, mixed them with wax and made a mysterious looking candle . . . and when I lit it, it burst into a blue flame."



"I wrote to several big chemical companies about my process, and before long one of them offered me \$1,150.00 in cash plus a contract guaranteeing me a 3-year position in their laboratories. Gee, it was swell to get that check, and you bet I'm glad I became a Gilbert Chemist."

Leading newspapers carried the story of Dennis' Triumph.

Candle Burns Blue

WAYNESBORO, PA., Oct. 22.—(I.N.S.)—Perfection of a candle that will burn a blue light has netted Dennis B. Collins, a fifteen-year-old Littlestown boy, exactly \$1,150 and the offer of a position with a Newark, N. J., chemical company.



Inventor's Outfit

How would you like to do what Dennis Collins has done! Have a chemical laboratory of your own. Make chemicals change color—transform liquids into sparkling crystals—and explore thousands of other chemical mysteries. You might even make a brand-new discovery and sell it for a lot of money.

The new Gilbert Inventor's Laboratory Outfit makes you a real chemist. It contains enough chemicals to make hundreds of compounds—test tubes, mortar and pestle and other fascinating equipment. Packed in a handsome laboratory kit, with metal work tray and detachable legs. Complete with three exciting books. *Chemistry, Chemical Magic and Glass Blowing*, \$10.00. Other Gilbert Outfits from \$1 up.

Ask to see them at your local dealer's. But be sure it's a Gilbert outfit.



OUTFIT NO. 12

\$100 award to every boy who patents a chemical process

"Wonderful discoveries have been made in chemistry, but I believe even more wonderful ones are yet to be made. I would like to see more boys win honors like Dennis Collins. To every boy owning a Gilbert Chemistry Outfit and who secures a United States patent on a chemical process before he is 18 years old, I will present a check for \$100.00."

A.C. Gilbert

Free Chemistry Book—Fill out this coupon and mail it today for free copy of Mr. Gilbert's new Book, "How to Become a Chemist," illustrating and describing each outfit and telling you about the exciting experiments you can perform. Send for your copy now and also a free supply of secret code ink.
Mr. A. C. Gilbert, The A. C. Gilbert Co., 364 Erector Square, New Haven, Conn.
Please send—free—illustrated book, "How to Become a Chemist."

Name.....
Street.....
City..... State.....

AT LAST! A BOOK YOU HAVE ALWAYS WANTED
A REAL Encyclopedia
Complete in ONE VOLUME

Here it is at last—an encyclopedia you can really use! No more tedious wading through ponderous reference works of many volumes. Now the facts you need may be quickly found and quickly grasped. No more long, complicated treatises to study. Now the information you need is yours in the fewest, simplest words. The plan of this amazing book is to cover every branch of modern knowledge and to present the facts you need on every subject. In simple alphabetical order there are 22,000 short articles—easy to find, easy to read. In just a minute or two you get the important facts you are looking for. No longwinded discussions. No pedantic lectures. No waste of words and space. Just plain facts and simple explanations. Here are the broad fields of science, art, history, biography, literature—and all other fields of human thought and activity—condensed for quick reference in one marvelous, illustrated volume of over 1,300 pages. It is a book you have long waited for—a book you are in need of every day—a book that will save you time, money, work, and worry.

The Modern Encyclopedia

A MIRACLE OF COMPLETENESS

You will naturally ask "How is it possible to put a REAL encyclopedia complete into ONE volume and sell it for the amazingly low price of \$3.50?" The thing that makes this unheard-of compactness possible is that no space is wasted on unnecessary discussions or lengthy discourses that the average person has no use for. Instead of several columns to get the information you want, you will find here a half-column or less. But the *real facts* are here. Think of the saving in the time and effort, think of the ease and simplicity of getting the knowledge you need!

A Wonderful New Short-Cut to Information

Scholars, historians, scientists, have labored for generations to gather into voluminous reference-works the treasures of mankind's knowledge. But heretofore the vast store of information has not been easily available to most of us. Now in THE MODERN ENCYCLOPEDIA this wealth of knowledge is so skillfully condensed, so simply expressed, so conveniently arranged, that it is quickly at your service whenever you want it.

A New Library of World Knowledge

To outline the scope of this book would take many pages this size. Here is only a hint of the fascinating contents:

Arts and Sciences

BIOLOGY
SOCIOLOGY
PSYCHOLOGY
PHYSIOLOGY
EDUCATION
LITERATURE
MEDICINE
CHEMISTRY
PHYSICS
ELECTRICITY
RADIO
TELEVISION
AVIATION
MATHEMATICS
PAINTING
SCULPTURE
MUSIC
GEOLOGY
ASTRONOMY
ECONOMICS
etc., etc.

History

ANCIENT
MEDIEVAL
MODERN
EXPLORATION
DISCOVERY
WARS
REVOLUTIONS
ALLIANCES
etc., etc.

Biography

ARTISTS
AUTHORS
EXPLORERS
STATESMEN
SCIENTISTS
RULERS
MUSICIANS
DOCTORS
MERCHANTS
INVENTORS

AVIATORS

etc., etc.

Nature

BIRDS
BEASTS
REPTILES
FISH
INSECTS
FLOWERS
TREES
SEEDS
MICROBES
TERMITES
etc., etc.

Engineering

BRIDGES
DAMS
TUNNELS
BUILDINGS
CANALS
RAILROADS
etc., etc.

Examine It on Approval

Send the coupon at the right, with no money, to reserve your copy. We will notify you when the volume is ready to ship. Then send one dollar deposit and the book will be shipped prepaid for a week's examination. If you are not fully satisfied, return it and your dollar will be refunded to you at once. If you keep it, your deposit is your first payment and you pay the balance at the rate of \$1.00 per month.

FREE—32 Page Atlas of the World

If you mail this coupon at once, we will send you a gift of a splendid Atlas—32 pages of 4-color maps. You may keep it free even if you return the Modern Encyclopedia.

Light
enough to
hold easily
in one hand



Handy Thumb-
Notch Index For
Quick-Reference

Only
\$3⁵⁰
 Complete

22,000 ARTICLES—Brief but comprehensive. Simple, clear, interesting, authoritative. Just the facts you want.
1,250,000 WORDS—An enormous wealth of information—yet the type is large, clear, and easy to read.
1,160 ILLUSTRATIONS—Right in the text where you can see them when reading the subjects they illustrate.
OVER 1,300 PAGES—Heavy enough for durability and ease in turning pages, absolutely opaque so no type shows through, yet thin enough to make a book only 1 3/4 inches thick.
STURDY BINDING—Dark blue linen, handsome and strong. Stamped in gold. Tinted top. Thumb-Notch index.
SIZE 6 x 9 x 1 3/4 INCHES. Easy to handle, easy to use. Light enough to hold comfortably in one hand.

Mail This Coupon—Send No Money

Wm. H. Wise & Co., Publishers
 Dept. 8012, 50 West 47th St., New York, N. Y.

Reserve for me one copy of The Modern Encyclopedia. Notify me when ready to ship and I will send one dollar deposit. Ship fully prepaid for one week's free examination. If I return it you will refund my deposit at once. If I keep it the deposit is my first payment and I will send \$1 each month until the Special Price of \$3.50 (plus a few cents postage) has been paid.

Name _____

Address _____

RAYMOND J. BROWN, Editor
ARTHUR WAKELING, Home Workshop Editor
ALDEN P. ARMAGNAC, Associate Editor
SYDNEY OXBERRY, Art Editor

POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 123 • NUMBER 6
15 Cents a Copy • \$1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
381 Fourth Ave., New York

TABLE of CONTENTS for DECEMBER, 1933

Doctors Face Death Trailing Living Poisons of Mystery Diseases . . . 13

STERLING GLEASON reveals how scientists trace malignant organisms they cannot see

Radio Pen Writes in Letters of Fire on Far-Away Screen . . . 16

A new marvel of communication explained by GEORGE H. WALTZ, JR.

Crackup of Mighty Glacier Caught for First Time by Sound Camera 24

Thrilling adventures with ZOLTAN J. KEGL in filming the birth of icebergs

Three American Chinchilla Farms Produce Most Costly Furs . . . 32

ANDREW R. BOONE tells how a mining engineer's enterprise started a profitable new industry

Flies Down Radio Beam Through a Mile of Fog . . . 34

DICK BOWMAN, pioneer transport pilot, takes you on an exciting aerial journey

How to Check Up on Time and the Seasons . . . 38

GAYLORD JOHNSON presents a simple way to find true north, and other fascinating experiments

Accidents Still Produce Great Inventions . . . 40

True stories of lucky discoveries told by EDWARD THOMAS, patent attorney

Huge Truck for Land or Water Carries Shipload of Cargo . . . 49

A university professor turns designer to forecast an amazing juggernaut of the future

December, 1933, Vol. 123, No. 6. Popular Science Monthly is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1933, by the Popular Science Publishing Co., Inc. Single copy, 15 cents (20 cents in Canada). Yearly subscriptions to United States and its possessions, \$1.50; foreign countries, including Canada, \$2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, Popular Science Monthly does not underwrite the business methods of the individuals or concerns producing them. The use of Popular Science Monthly articles for stock-selling schemes is never authorized.

FEATURES AND DEPARTMENTS

Our Readers Say— . . . 10

Microscope Marvels in Workshop 44

Home Tests with Calcium . . . 52

Easy Way to Spot New Stations . . . 57

Ultra-Short-Wave Radio . . . 58

Quick Starts on Cold Mornings . . . 60

The Home Workshop . . . 61

A Camera Record of Your Home 68

New Hints for Car Workers . . . 72

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

"Snowmobile" for Antarctica . . . 19

Automatic Mixture Control . . . 19

Asbestos Piston Rings . . . 21

Car Led from Door to Door . . . 21

Forty-Pound Automobile . . . 29

Shows Dirt in Car's Oil . . . 48

AVIATION

Find Sky Violet 11 Miles Up . . . 19

Stereoscope for Air Photos . . . 22

Biggest Sky Sign Flown . . . 42

Plane Towed to Air Field . . . 50

New Transcontinental Air Liner . . . 51

ENGINEERING

New Way to Erect Columns . . . 18



overshadows them all!

NO beard can browbeat a Gem. Stubble that takes the heart out of other blades . . . swiftly and meekly yields to Gem's tougher edge, sharpened to frog-hair fineness by 4840 separate stroppings.

But even this super-keenness would be partly lost if Gem hadn't patented dual-alignment, which adjusts edges so precisely that not a bristle or contour can escape its swift, smooth, non-scuffing stroke.

Note the one-piece frame. Note that there are no removable parts—nothing to break—nothing to get out of order—nothing to mislay.

Note the bevelled top, with the correct stroke shaped in the design, so that you're *compelled* to shave at the correct barber-shop angle.

Note how one numbered edge is protectively covered until the other has been used to the limit.

Note that Gem Micromatic Blades are 50% thicker to get that deep wedge-edge so dear to heavy stubble and tender skins. We make them of the toughest surgical steel. They last so much *longer* that there's *less shaving* and *no saving* in "scrap-heap" substitutes.

The first razor to fit either single- or double-edged blades (provided they're Gems). The first razor so confident of its perfection that we'll mail a trial set, with a single- and a double-edged blade and the *exact* gold-plated frame included in Gem's regular \$1 outfits, for 25c.

Coupon, do your duty!



© G. S. R. C. 1933

Gem Safety Razor Corp., Dept. P.S.1, Bklyn., N.Y.
Enclosed find 25c for complete trial Gem set with a single- and a double-edge blade and the same gold-plated Gem Micromatic Razor now featured in regular \$1.00 outfits.

PRINT NAME _____

ADDRESS _____

GEM MICROMATIC RAZOR AND BLADES

POPULAR SCIENCE MONTHLY FOR DECEMBER, 1933

Bridge Rises in High Water . . .	21
America's Oldest Road Roller . . .	30
New Tools Straighten Oil Wells . . .	46
World's Mightiest Dredge . . .	50

MODELS

Official Makes Locomotive Models . . .	30
Simple Clipper Ship Model . . .	66
Kit for Clipper Ship . . .	74
Many Parts Made at Once . . .	87

NEW DEVICES FOR THE HOME

Up-to-Date Coal Stove . . .	54
Sink-Drain Strainer . . .	54
Bath Mittens . . .	54
Pump Broom . . .	54
To Time Eggs . . .	54
Toaster Compartment . . .	54
Electric Fryer . . .	55
Cord Reels Up . . .	55
Grinds Own Coal . . .	55
Medicine Spoon . . .	55
Typewriter Table . . .	55
Seals the Tube . . .	55
Makes Rugs Non-Skid . . .	55
Saves Toothpaste . . .	55

NEW PROCESSES AND INVENTIONS

Foot-Pedal Accordion . . .	22
Tool Applies Wire Bands . . .	22
New Motor Has Dual Pistons . . .	22
Jig-Saw Kit for Toy Furniture . . .	28
Flashlight Cells Work Phone . . .	29
"Rail Plane" for 90-Mile Speed . . .	31
Adjustable-Point Fountain Pen . . .	42
Heat Closes Fireproof Shutter . . .	42

Carbon Disks Copy Typewriting . . .	43
Mail Box Delivers Letters . . .	43
Convertible Spectacles . . .	43
Five-Section Subway Car . . .	47
Camera Guides Ship in Fog . . .	48
Lead Fed to New Pencil . . .	50
Films Aid New Television Process . . .	51

UNUSUAL FACTS AND IDEAS

Rudder for Biggest Liner . . .	18
Monument of Broken China . . .	18
Machine Tests Dental Fillings . . .	18
Midget Tubes for Micro Waves . . .	19
Statue of Christ 30 Feet High . . .	20

Announcing . . .

The National Homeworkshop Guild

Turn to page sixty-two and read how this new organization, devoted exclusively to the amateur craftsman, will help you to find more pleasure and profit in your spare-time hobbies

Safe Drug Takes Off Weight . . .	20
Movable Pilot House for Tug . . .	21
Experts Save Last of Totem Poles . . .	23
Girl Fights Octopus for Movies . . .	27
World Hunt for Quartz Prisms . . .	28
Radio Singer in Cellophane Bell . . .	28
Biggest Clock Has No Hands . . .	29
Bass Viols Made of Aluminum . . .	31

Make Ropes on "Telegraph Poles" . . .	31
Marvels of Newest Observatory . . .	37
Play at War on New Chess Board . . .	43
Bicycle Streamlined for Speed . . .	47
Traffic Lights for Harbor . . .	47
Cyclists' Molded Masks . . .	47
Homemade Device Makes 'Quakes . . .	48
Umbrella Leaves Worn in Jungle . . .	50
How Stars Are Measured . . .	56

FOR THE HOME OWNER

Waterproofing Paper . . .	76
Holder for Rubber Bands . . .	78
Winder for Clotheslines . . .	88
Typing Adhesive Labels . . .	91

WOODWORKING

An Upholstered Stool . . .	80
Home Workshop Blueprints . . .	84
Transferring Patterns . . .	86
A Light Drafting Table . . .	100

IDEAS FOR THE HANDY MAN

Comic-Strip "Talkies" . . .	61
Christmas Lighting Stunts . . .	64
Knotted Cord Key Case . . .	73
Gumming a Cordwood Saw . . .	76
Making a Sawdust Chute . . .	78
Homemade Set of Weights . . .	79
A Soldering Copper Hint . . .	83
Ring Holds Hack-Saw Blades . . .	86
Making Sandpaper Sticks . . .	86
Repairing Jig-Saw Puzzles . . .	87
Laying Out Drilled Holes . . .	88
Ash-Tray Ornaments . . .	90

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

You Are Invited to Accept a FREE MEMBERSHIP in the DOUBLEDAY ONE DOLLAR BOOK CLUB!

Get a book that was published at \$2
to \$3.50, like this, each month,
for only \$1

HAVE you heard of this new way to save from \$1 to \$2.50 or more on a good book every month?

If you would like to obtain books at half price or less you too will be interested in the Doubleday One Dollar Book Club. There is no enrollment fee. There are no dues. You are not obliged to buy a book every month. You do not have to agree to buy any particular number of books. You simply are offered a real saving on outstanding volumes—worth reading and owning—when you wish to buy them!

"WILLIAM PITT," by P. W. Wilson, is only one of the many fascinating books to which Club Mem-

bers have been entitled in recent months. Carefully chosen for interest, permanent value, and literary excellence, the Club's monthly selections include \$2 to \$3.50 books of fiction, biography, travel, adventure, history. Not "cheap reprints," but ORIGINAL EDITIONS or editions identical with the original. And each one you take costs only ONE DOLLAR! If you do decide to take one book each month, you save from \$12 to \$30 a year on your reading.

If you are building a library; if you welcome a logical way to genuine savings—then read how you can now enjoy the benefits of this proved plan.

Join—Without Cost—the Book Lovers Who Are Saving Money This New Way

The books selected by the Club are exceptional titles—in many cases BEST SELLERS, for among them you will find outstanding books to please every reading taste—novels, biographies, tales of adventure by land or sea, books of essays or of history, books in every class of literature. The authors are most certain to appeal to the majority of our members. In past months these have included John Drinkwater, H. G. Wells, W. Somerset Maugham, Clemence Dane, V. Sackville West, Harold Lamb, Robert Hichens and William McFee. Surely they mean reading pleasure and reading profit! However, you do not have to accept the Club's selection. Your own tastes are free to choose from the Club's lists, to substitute, to return, just as you wish. The only thing you can't help doing is to SAVE MONEY every time you do buy a book!

FREE Enrollment—FREE SERVICE

The Doubleday One Dollar Book Club asks no enrollment fees or membership dues. You pay nothing for the service of having outstanding books recommended to you—books you really want to read!

Each book is individual. There is no "standard binding." "WILLIAM PITT," for example, is printed on fine antique paper, deckle-edge with stained page tops; bound in lustrous black cloth, tastefully stamped in gold, and with a two-color jacket.

You TAKE Only as Many Books as You WANT

Remember, you do not have to accept the Club Selection. You may select an alternative book or you may decide not to take a book that month at all. You may even drop your membership entirely any time you want to!

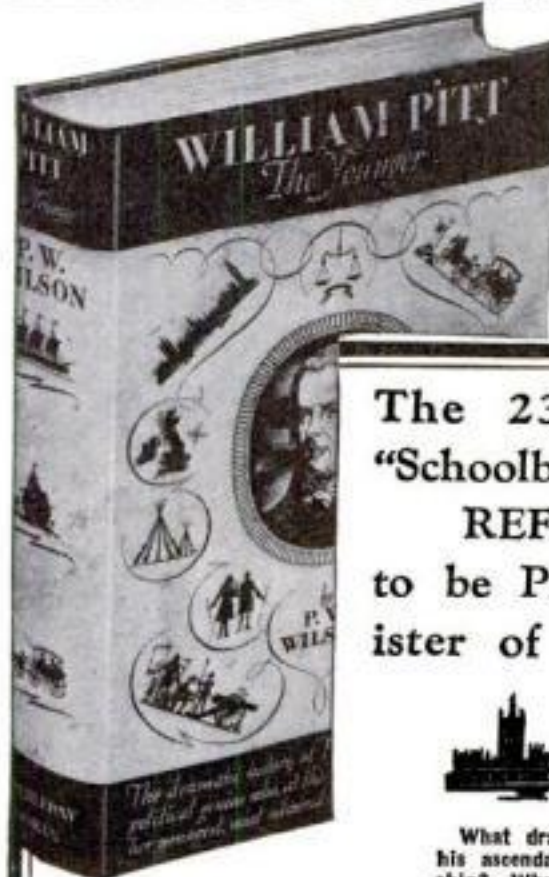
During the year, there will be 12 monthly selections and 200 to 300 alternative books—good books, every one of them. YOU are the one to decide how many of them you wish. And you know in advance that each book will cost ONLY A DOLLAR.

See for Yourself—AT OUR RISK— How Delighted You Will Be with this Common-Sense Plan

You Need Send No Money with this Coupon

We invite you to try membership in the Doubleday One Dollar Book Club. Unless you are more than pleased with "William Pitt," the trial will cost you nothing. And it will place you under no obligation.

Send the coupon to us now without money. We will send you "WILLIAM PITT," postage prepaid. Examine and read it. If you like it—keep it and we will bill you at the special Club price of \$1 plus the small postage charge of 10c. Each month, then, you will have the privilege of examining the monthly selection before you remit for it. But if "WILLIAM PITT" (or any other book, later on) does not appeal to you—return it and you pay nothing. Could anything be simpler, or fairer? You take no risk. Mail the coupon now. Address: DOUBLEDAY ONE DOLLAR BOOK CLUB, Dept. 9812, Garden City, N. Y.



IDENTICAL WITH
ORIGINAL EDITION

Size 5 1/4 by 8 1/4
inches, over 350
pages, large read-
able type, on high
grade book paper.
Tinted top, hand-
some cloth binding
and two-color wrap-
per. Published at
\$3.00.

The 23-year-old "Schoolboy" Who REFUSED to be Prime Min- ister of England!



What dramatic signal flashed his ascendancy to the premiership? What was the outcome when he dared stake his all against the sternly sen- suous Catherine the Great of Russia? What happened when he, unskilled in military tactics, ruthlessly drew swords with Napoleon?



With a dissolute tyrant de- spoiling far-off India, what did he engineer to subdue the oppo- sition? How did this compara- tive child make fools of vigorous leaders old enough to be his sire? What vice probably cut short his life in its prime?

He wrote England's history in blood, in poison, and in the honey of veiled diplomacy. At- most unbelievable coups of in- trigue and triumphs of brilliant strategy were woven into his spectacular career. How? Read this book. Know this man. You will search all history for a more unique story!

AT 23 he refused the Pre- miership of Britain. At 24 he accepted. No wonder a poem of the day exclaimed:

"A sight to make sur- rounding nations stare— A kingdom trusted to a schoolboy's care!"

What an amazing character! The most precocious genius in all the annals of British statesmanship.

Up to now, no biography of his astounding life has been both authentic and thrilling. Now the story of William Pitt, the Younger, is told with breathless fascination. Who was this man? Why did he tower so giganti- cally over his friends, so de- cisively over his enemies?

Why It Will PAY You to Send the Coupon NOW!

It costs you NOTH- ING to join.

You pay NO month- ly or yearly "dues".

You do not have to take a book each month unless you wish to.

You do not have to buy any particular num- ber of books.

You SAVE \$1 to \$2.50 or more on every book you do take.

The books offered are BEST SELLERS— or books whose permanent value and enjoyability make them well worth reading and owning.

You may read and ex- amine EVERY book before you decide wheth- er you wish to keep it.

You take NO RISK in learning full details by sending the coupon NOW.

DOUBLEDAY ONE DOLLAR BOOK CLUB
Dept. 9812, Garden City, N. Y.



Please enroll me free as a Club Member and send me each month the Monthly Bulletin and the book selected, commencing with WILLIAM PITT. I will examine each Book Selection for three days and if I decide to keep it, I will send you the Club price of \$1.00 plus the small postage charge of ten cents. If I do not like it, I will return it to you, in which case I am to have the privilege of choosing alternative book, if I wish, from the list in the Bulletin. I am not obligated as a Club Member in any way except to pay for the books which I decide to keep. I am to be free to discontinue membership at any time I wish.

Name.....

Street and No.....

City.....State.....

Occupation.....

Enrollments of minors must be signed by father or mother

Winter is Coming!

BE SURE TO

SIMONIZ

YOUR CAR



MOTORISTS everywhere are now Simonizing their cars to protect the finish for winter driving.

SIMONIZ
Protects
the Finish
and keeps it
Beautiful

Nothing takes the place of Simoniz. It protects the finish in all weather, makes it last longer and keeps the colors from fading. Harder. More lasting. Simoniz gives perfect protection to all cars old or new.

You'll enjoy Simonizing your car. It's easy. If the finish is dull, use the wonderful Simoniz Kleener first. It makes your car look new in a jiffy . . . and without any hard rubbing. Then apply Simoniz. It keeps your car al-

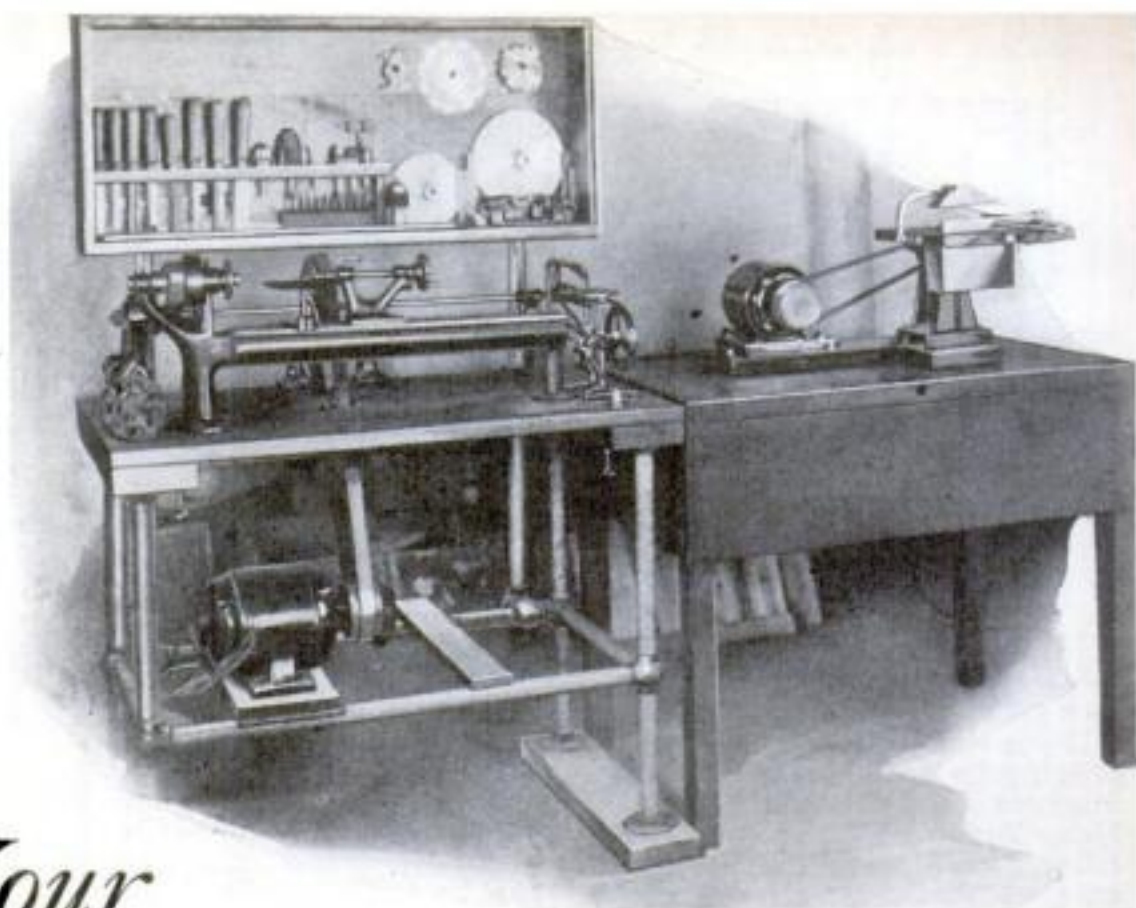
ways bright and new looking.

Insist on Simoniz and Simoniz Kleener for your car. At hardware and accessory stores everywhere.



Always Simoniz a New Car

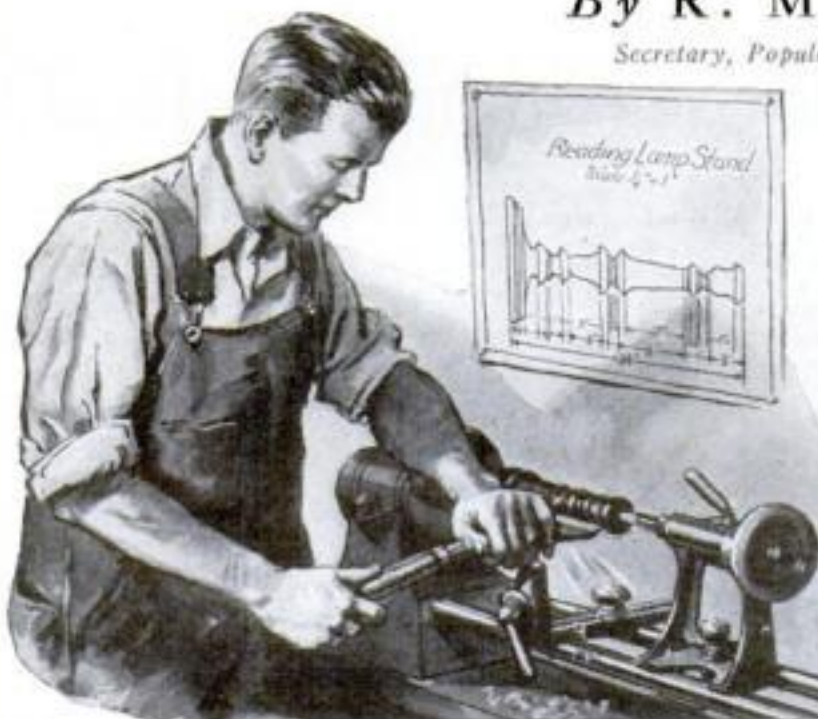
MOTORISTS WISE • SIMONIZ



Your Motorized Workshop

By R. M. BOLEN

Secretary, Popular Science Institute



With motor-driven tools, all the expert's tricks are in novice's hands.

more fun, more play, and more time for the details. With motor-driven tools, all the tricks of the expert are placed in the hands of the novice. Tedious tasks are simplified and roundabout jobs shortened.

When you let electricity do the work, the usefulness of your shop is doubled. Two projects grow where one grew before. Mistakes are fewer, experience less of a necessity, and the finished products nearer perfection.

"But," you may say, "motor-driven tools are an expensive luxury. I'd like a modern shop as much as the next fellow, but I can't

afford it, so why think about it?"

At present prices, anyone who can afford a shop and a hobby can afford motorized tools. High-grade machines were never cheaper. Carefully designed lightweight shops consisting of a bench saw, lathe, planer, jig saw, band saw, and motor can be bought for less than \$70 while individual units sell for little more than the price of a good hat.

In fact, good motorized equipment is available at all sorts of prices. Like automobiles, they can be grouped into well-separated price ranges, each fulfilling a need and offering good value for the money. No matter what your requirements, there are motorized tools that will fit your pocketbook as well as your needs.

For less than ten dollars, you can place a safe, though lightweight, bench saw in your shop while *(Continued on page 9)*

TO THE dyed-in-the-wool home workshop fan, the N. R. A. means one thing in particular—more time for tools.

All over the country, thousands of men, young and old, are sharpening tools, planning new projects, and rearranging shops. With more time for play, every amateur woodworker feels that at last he can get the most out of his fascinating hobby.

But the real answer lies in motor-driven tools. For until you have fed wood into the buzzing teeth of a bench saw, cut whirring spindles in a lathe, and held stock against the nibbling blades of a planer, you have missed the biggest thrills your home workshop can offer.

Like the N.R.A., motorized tools mark a new era for the amateur. Both mean

... *Little Stories of*
PROGRESS—and
those who make it ...

No. 1 of a SERIES

"The MAGIC EYE *that Sees Across the* OCEAN"

SEVEN years ago, in a story called "The Magic Eye that Sees Across the Ocean", this magazine reported the latest triumph of the photo-electric cell in enabling engineers to transmit long-distance pictures successfully. The photo-electric cell was then far from being a new invention. But it was still waiting, as we pointed out in this article, for the world to discover its many other uses . . . a world that thought the "magic eye" a tricky gadget whose commercial possibilities were not to be taken too seriously. But then, there will always be thousands standing on some river bank and jeering at the Robert Fultons . . . the same thousands who later cross the seas on palatial liners.

Today men are making this photo-electric cell count and check articles on production lines, sort colors and sizes, protect their homes and factories—all without human aid. Only a few months ago the "magic eye" captured a beam of light from the far-off star, Arcturus . . . and The Century of Progress at Chicago was opened in a brilliant blaze of glory.

Readers of Popular Science Monthly were quick to see the possibilities of the photo-electric cell—and among them were the first men to put it right to work, because these men recognized the authority and the timeliness of this magazine which brought—and still brings—the first reports of all new inventions and products.

Although the rest of the world is always slow to learn, you—as a reader of Popular Science Monthly—may find today the report of something new that will help you in your own business. In these pages, from month to month, you may find the hint that will give you the jump on the world . . . and on your competitors.

Popular Science is the news monthly of Progress—and Progress is the keystone of modern business. You can rely on this magazine for the FIRST reports of science's new ways to help you. Almost half a million men, seeking other "magic eyes", are doing so now.



HEARING AID

...by Bell Telephone

makers—assures clear,
natural sound

IMPAIRED HEARING need not be a handicap to you. For Western Electric — maker of your Bell Telephone — offers you a most helpful Hearing Aid.

This Audiphone can bring you every sound naturally and clearly, whether your hearing impairment is slight or severe. There are three Western Electric models — all light, compact, easy to wear.

Your Audiphone dealer will gladly help you find the model that's best for you. Send the coupon for his name and address.

Distributors in Canada: Northern Electric Co., Ltd.

Western Electric HEARING AID

GRAYBAR ELECTRIC CO.
Graybar Building, New York, N. Y.

Gentlemen: Please send me full information on the Western Electric Audiphone and name of nearest dealer.

NAME _____
ADDRESS _____
CITY _____ STATE _____



New Construction Kit FOR A Clipper Ship Model

EVERYTHING you need to make a beautiful little miniature model of the famous American clipper *Sea Witch* is contained in a new construction kit offered by the Popular Science Homecraft Guild. Unlike all previous clipper ship models, this one has been so greatly simplified that anyone can build it. Indeed, it is what is called a "pocketknife" model because so much of the work can be done with a penknife and a few single-edged razor blades.

The hull of the model is 9½ in. long, but the over-all length is 13 in., and it stands 8 in. high. The kit contains the hull carefully sawed to shape by hand from accurate master templates; half a dozen pieces of pine cut to approximate sizes for the deck fittings and boats; hardwood for the keel, stem, sternpost, rudder, and other parts; three sizes of round stock for the masts and spars; fiber for crosstrees and caps; thin hand-dyed linen rigging cord of the finest quality; thread, small chain, beads, fine wire, casein glue—in fact everything but the paint.

Postpaid Complete \$1.50

Popular Science Homecraft Guild,
381 Fourth Ave., New York, N. Y.

Please send me a complete construction kit (except paints) and a blueprint for building a miniature model of the clipper ship *Sea Witch*. I enclose \$1.50.

Name _____

Address _____

City _____ State _____

(Print very clearly)

NOTE: This kit is not sent C. O. D.

MAKE GIFTS FOR CHRISTMAS with

There are scores of useful, ornamental, lasting gifts you can make for Christmas with Duco Cement. No difference what materials you use. This really wonderful adhesive holds permanently on everything except rubber.

Don't compare Duco Cement with ordinary adhesives. It's transparent, waterproof, quick-drying, easy to use, flexible. Here's another hint: Give it as a Christmas gift to any member of the family. 25c a tube at drug, stationery and hardware stores. Send for valuable folder of tips on making and mending with Duco Cement to DU PONT, Dept. P-12, Wilmington, Del.



Statement of Ownership, Management, Circulation, etc., required by the Act of Congress of March 3, 1933, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1933, State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared A. L. Cole, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of March 3, 1933, embodied in Section 537, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are Publisher, Popular Science Publishing Co., Inc., 381 Fourth Avenue, New York, N. Y.; Editor, Raymond J. Brown, 381 Fourth Avenue, New York, N. Y.; Managing Editor, Raymond J. Brown, 381 Fourth Avenue, New York, N. Y.; Business Manager, A. L. Cole, 381 Fourth Avenue, New York, N. Y. 2. That the owners are: Popular Science Publishing Company, Inc., 381 Fourth Avenue, New York, N. Y.; Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 230 Park Ave., New York, N. Y.; Oliver B. Cason, 381 Fourth Avenue, New York, N. Y.; Robert Wade Wilson, 683 Springfield Avenue, Summit, N. J.; Ada B. Wilson, 683 Springfield Avenue, Summit, N. J.; A. L. Cole, 381 Fourth Avenue, New York, N. Y.; John Nichols, 381 Fourth Avenue, New York, N. Y. 3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: none. 4. That the two paragraphs next above giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear on the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) A. L. Cole, Business Manager.
Sworn to and subscribed before me this 20th day of September, 1933.
Esther Eyl, Notary Public, Kings County Clerk's No. 54, Registry No. 4059, New York County Clerk's No. 144, Reg. No. 4871.
(Seal) My Commission expires March 30, 1934.



FREE to BOYS

Sample Copy of OPEN ROAD for BOYS Magazine, 50 pages thrilling stories, pictures, sports, mystery, etc. Free membership in WINNIT CLUB, badge button, big outfit, catalog and new plan for getting money and swell prizes. Big surprise, too! ALL FREE! No obligation.

Write today to WINNIT CLUB 70
Open Road For Boys
130 Newbury Street, Boston, Mass.



*I dare you
to race my
Flexible
Flyer*

But what a dare! Flexible Flyer is the speed demon on runners. Nothing can pass it, nothing can equal it but another Flexible Flyer. Every steep hill, every horseshoe curve, every straightaway calls for a Flexible Flyer. But only a coasting fan—only a sledding expert can feel the full thrill of power, the smooth speed under superb control, of Flexible Flyer—the sled unchallenged for half a century.

"Super-Steering" is the most recent Flexible Flyer achievement, with its extra protection and instant stabilization. "Super-Steering" plus non-skid, spring steel runners, steel front and bumpers, reinforced seat supports of pressed steel, polished hard wood, give you the finest sled in the world—Flexible Flyer.

Flexible Flyer is shown in eight sizes—in prices from \$3.50 to \$12.00. Tuxedo in polished chromium and solid walnut is the flagship of the Flexible Flyer fleet.

Worth waiting for, worth saving for—Flexible Flyer lasts a lifetime of fun.

S. L. ALLEN & CO., Inc.
443 Glenwood Avenue, Philadelphia, Pa.

Makers also of
Planet Jr. Farm and Garden Implements

Boys and girls you can have a miniature model of the famous Flexible Flyer FREE. Just send your request to the above address.

**Flexible
Flyer**



YOUR MOTORIZED WORKSHOP

(Continued from page 6)

thirty dollars will buy you a semi-professional outfit that is larger and heavier. Jig saws range in price from a few dollars upward and woodworking lathes from seven dollars to over forty.

Perhaps you do not want a complete motor-driven shop. Well and good. There is no need to invest in a complete outfit to enjoy some of the benefits of motorized tools. If you buy only a good circular saw you will be going a long way toward modernizing your shop. It will save you time and your work will be easier and more interesting.

The same can be said of the lathe. In fact, few tools will do more than the bench saw and lathe to widen the scope of a hand-tool shop. They will be your passport to more intricate designs. Immediately your choice of projects will be greater, the output of your shop more artistic.

The first thing to do when planning a motorized shop is to decide which branches of the woodworking or metal working hobbies interests you most. Once you have analyzed your interests it will be easy to pick out those tools that will add the most to your shop. In time, you will want to add others. The important thing is to motorize and enjoy woodworking the modern way.

The same holds true with the hobby of metal working. If you are interested in building model locomotives and miniature trains, your shop will not be complete until it boasts a good metal lathe. Countless model making jobs require turned parts that can be made in your own shop for a fraction of their cost ready-made.

If you are like the average individual, your home workshop will be a life-long hobby. For this reason, you can not choose your equipment too carefully. Decide what you want and what you want to spend and then get the best for your money.

To readers who are interested in adding motor-driven tools to their shop, Popular Science Institute offers the following advice: Send for the catalogs of all the motorized tool manufacturers, consider the advantages of each make, and buy the equipment that best fits your pocket-book and your needs. But most important of all, buy from reputable manufacturers such as those whose products bear the seal of the Popular Science Institute.

PHOTOGRAPHS WANTED

To find out more about amateur shops, Popular Science Institute is collecting photographs of hand-tool and motorized workshops. If you have a home workshop, no matter how small, take several pictures of it and send them together with a description and a list of your hobbies to Popular Science Institute, 381 Fourth Avenue, New York, N. Y.



*Clear the track
for
Flexy Racer*

Flexy Racer—twin brother of the famous Flexible Flyer. Flexy Racer—the Flexible Flyer on wheels—the fastest, smoothest, safest coaster in the world. Swings instantly from high to low speed—races like a thoroughbred, always under control—cuts the wind like a blade and stops in a split second.

Healthful fun from five to fifty. Light enough for boy handling—sturdy enough for man handling.

Silent as a high priced motor car—positive two-wheel brakes—balanced spring steering—live rubber tires—handles like Flexible Flyer. Made to use and made to last.

All yours for a merry Christmas—Flexy Racer.

Flexy Racer, the Flexible Flyer on wheels. And the new Flexy—a junior in age and a junior in price. Priced from \$5.95 to \$8.50.

S. L. ALLEN & CO., Inc.
443 Glenwood Avenue, Philadelphia, Pa.

Makers also of
Planet Jr. Farm and Garden Implements

**Flexy
Racer**



Our Readers Say



Go to the Bee, Thou Crooner, And Learn About Broadcasting

THE excellent article by Robert E. Martin, "Nature Invented Them First," could be followed by one on "Insects as Radiotricians." This idea is not so preposterous as it seems. Many insects have appendages which are neither ornaments nor

weapons, yet are in some way connected with the creatures' existence. A guess that it is some form of radio communication is not so wild as one might think at first glance. By reasoning from analogy, we find some of them capable of broadcasting on a frequency so high that it is light, which we can see. A different frequency would be intelligible only to an organ developed for that purpose. We have gone to the insects for a name for one of the most important parts of a radio broadcasting and receiving set, the antenna, many types of which we find in the insect world. Here are some of them: The horizontal antenna is used by the cockroach. The vertical antenna by the guaba, a scorpionlike creature found in the tropics. The semi-vertical antenna is used by bees and wasps. The fan-type antenna used by moths and butterflies. The ball antenna used by snails. This small globe, carried in pairs on an extensible pole, is mistaken for the eyes. A close examination of the creature will show that the eyes are in the front part of the forehead and are not movable, while the small globes are capable of being withdrawn into the creature's body. The exactness with which the worker bee goes to the hive with his load of pollen is still a mystery. How does he do it? Regardless of weather, a radio signal would guide him as it does an aviator and maybe that's what he uses.—R.P.D., San Antonio, Texas.

HM-M, MAYBE
THAT'S WHY RADIO
DRIVES YOU BUGS



Here's One Kick at Least We Can't Be Blamed For

AS THE result of an argument on the following subject, I am asking you to supply the answer, if you find the subject interesting enough to publish. What causes the KICK in a gun? A claims the kick starts at the moment of the explosion. B claims the kick starts at the moment the bullet leaves the barrel. A says the explosion must produce a kick as the bullet is a resistance. B says the internal explosion is equal all around and the bullet, offering the least resistance must move forward, but does not (kick) force the gun back. The kick is caused by the force of the explosion (not the bullet) striking the atmosphere immediately after the bullet leaves the barrel. Every bit of information any of your readers can offer will be more than appreciated.—H.G., New York, N. Y.

ANYWAY, IT STILL
KICKS



Inspiration Isn't Exactly What Some Would Call It

I THINK it quite remarkable that some of POPULAR SCIENCE MONTHLY readers are so much wiser than Einstein and Jeans and Eddington and other accepted scientific authorities. Some readers have no hesitancy in telling us exactly what space, radio waves, X-rays, electrons, protons, and even the ether are. All of this remarkable information they have acquired without performing a single experiment or making one calculation. Probably they received their data through some peculiarly enlightening form of second sight or inspiration of doubtful origin.—S.P.F., Los Angeles, Calif.

Descendant of Kings Makes Our Solid Scale Models

I HAVE been making several of your solid scale models and have sold a few. Now I should like to make a solid scale model of the wartime Spad and SE-5, the models to be the same scale as the Fokker D-7. I am a direct descendant of King Louis XVI of France and so would like to get a copy or description of his coat of arms.—T.N.T., Cavalier, N. D.

Here's Moon Madness Setting A New All-Time Record

OF ALL the plans for signaling to the moon, lunar television is probably the most simple. All that is needed are some shovels and some water. When inhabitants of any other planet see the earth, they should be able to detect the difference between land and water. If we go out and dig a big mud puddle, people on the moon should see it. No fancy radio gadgets, wires, nor mental telepathy are needed. The only requirement would be, for a picture 500 miles square, about one shovel and one man per acre, for 16,000,000 acres; and about 320,000,000,000 buckets of water. Wasn't it Edison who said something about genius being ninety-nine per cent perspiration? Here's my one per cent!—W.S.K., San Francisco, Calif.



Triangle Problem Draws Almost Instant Reply

CONCERNING the right-angle triangle asked for by P.C., Troy, N. Y., I'd like to say that any triangle in the proportion, short side, 1.000; long side, 1.271; hypotenuse, 1.618, will meet the conditions. His problem involving the radius of the circle as illustrated is of course merely a trick. Draw the diagonal of the rectangle from the center of the circle, and the radius is obviously five inches. With regard to the numbers asked for by

N.D.W., San Bernardino, Calif., there are two sets of such numbers, depending on whether the numerical value of y is plus or minus: X equals 2.618, y equals 1.618; or X equals 0.382, y equals -0.618. I note that one of your correspondents says that the soap bubble problem can only be solved by calculus. I solved it first by algebra.—J.S.H., Tenafly, N. J.

This Racing Bug Gets In a Mixup with Nitrogen

A FEW days ago a crowd of us automobile racing bugs got to talking about the tricks that drivers use to win races. One of the gang told about an article he had read in some magazine. It claimed that the latest trick consisted of filling the tires on racing cars with nitrogen gas instead of air. Immediately everyone wanted to know why nitrogen gas was any better than air. We argued for hours but couldn't come to any conclusions. My guess was that it had something to do with the relative speeds of diffusion of nitrogen and air through the rubber and fabric tire walls. Someone else seemed to think that it had something to do with expansion and heat. What do you think? Perhaps some of your readers who know a little more than we do about it can set us straight.—J.K.F., Cincinnati, Ohio.

HECK, I THOUGHT
YOU SAID HYDROGEN!



World Fair Exhibit Was "Simply Wonderful"

I HAVE just come back from the World's Fair at Chicago. I saw your exhibit there and I can't tell you how much I enjoyed it. The way those gears worked is simply wonderful.—H.W.K., Omaha, Nebr.

Stalin Won't Thank You for Bringing This Matter Up

Too bad, in your article last month on the weather, that you didn't give some space to the great and glorious work of the Soviet Commission for the Prevention of Snowfall over Cities. Last winter, the papers told us, the Soviet Government got the idea that it would save a lot of trouble for the street-cleaning squads if snow didn't fall; so it decided to abolish it. The technical experts said it could be done by sending up observation balloons with electric ionization apparatus whenever snow threatened. Perhaps for their big demonstration they deliberately chose, as some cruelly suggest, a day when no snow was expected anyway. But greatly to their



consternation, hardly had they got their apparatus working when snow began to fall in great white flakes. Since then, strangely enough, I haven't seen a thing in the news about the Soviet Commission for the Prevention of Snowfall over Cities.—G.H.W., Duluth, Minn.

Colorado River Toad Is New Expert on Perfumes

SOME time ago there was a question submitted to "Our Readers Say," concerning poisonous frogs, or toads. Your readers probably have heard of the Colorado River toad which makes its home along that river, and throughout the Southwest. The color of this toad is a muddy green. It is a huge fellow, and is capable of exuding a poisonous substance from his skin. Many a small dog has gone to the happy hunting ground after biting one of these toads. Men have become ill from handling the toad, but I have never heard of a fatality. Like most poisonous things, this toad has a method of warning offenders—a very disagreeable odor. I speak from first-hand experience as six of the toads make their home in my garden, but do not bother us in the least unless they are disturbed. They wage an endless war on worms and insects, and for that reason I consider them an asset.—E.W.B., Winkelman, Ariz.



Here's One Final Blast At All Evolutionists

J.H.P., I do not know whether to be sorry for you or to laugh at you. Any embryologist knows that there is no similarity of structure or function between the human embryo and the fish. The so-called gill-slits are nothing more nor less than pharyngeal arches. They are gills in no sense of the word, and if they were, would afford no proof of the theory of evolution, for the argument from similarity has been exploded. When a theorist resorts to such feeble supports, he is weak indeed. As for the Bible, it contains no fairy story, untrue statement, or fallacy, so provable by any established modern science. Are you well acquainted with the entire contents of the Bible and with the pertinent findings of archeology? Until you have assimilated both sides of the argument, you have not shown intellectual honesty.—W.H.R., Jr., Moorestown, N. J.

If You Get Past This One, We'll Have a Hard Winter

FOR centuries, human beings have attempted to unveil the mystery that surrounds their existence on earth, only to meet with complete failure. The hidden barrier that so consistently guards the secret of creation can not be passed by mankind, and the theories that scientists are constantly advancing are worthless. How can man, a mere mechanism, hope to penetrate into the Great Beyond? Is it not enough that we are here and enjoy life? The thought of man solving the enigma of life is incredible! Gradually, the wise man comes to the conclusion that life is too sacred a thing to be a subject of controversy among mere mortals, and so he leaves the question dangling in mid-air, unanswered.—F.B., Reading, Pa.



Bottling Ether Is Difficult Since No One Can Find It

PERMIT me to tell you, E.C.J., Westport, Conn., that ether is not a material substance as supposed by many but merely a concept that was originated in the nineteenth century because of the apparent necessity for some medium to transmit light and electromagnetic waves. The Theory of Relativity, while still a theory, disproves the existence of an ether. Your scheme for bottling ether will not work since ether does not exist in the form in which you have conceived it.—J.J.T., Shadyside, Ohio.

Pull of Those Horses Depends on Conditions

ANSWERING a question in a recent issue from O.L.G., Rockton, Ill., regarding the relative pull of the leading and lagging horse in a team, I would tell him that it depends on the way the doubletree is made and used. In the ordinary doubletree, the center hole for the pin is usually nearer the front while the holes for the singletree clevises are nearer the back. That is, the three holes are not in line, so when used this way the lagging horse gets a shortened end of the doubletree as it swings and therefore has an increasing share of the load to pull. Again the ordinary doubletree usually has a D on the back side. When the hitch is made in this, the reverse is true and the lagging horse has a decreasing share of the load because in this case the center fulcrum is back of the singletree fulcrums and as the doubletree swings, it lengthens the lagging horse's end giving that one a greater advantage. When the three holes or hitches are in line, neither horse gets any advantage when the doubletree swings. This reminds me of another question I have often heard raised: Does a load put principally on the front end of a wagon pull easier than if put principally on the rear? My own answer is that on a hard road there is no difference, but on soft dirt or in the mud, the closer the load is to the team, the more they can pull, providing the hitch is low enough to give a lift as well as a forward pull.—J.H.A., New London, Ohio.

FUNNY THEY DON'T ASK ME



This Worried Reader Wants A Crystal Iconoscope

WON'T some bright reader of POPULAR SCIENCE MONTHLY please answer my question? Here it is: Is a crystal iconoscope possible? If the impulses coming through a crystal are sufficient to actuate the magnets of an earphone, why shouldn't a crystal sensitive to television impulses actuate the magnets of kinescope (receiver) for scanning and also make a cathode-ray beam? The chances are ten to one that I'm wrong, but if somebody doesn't tell me if I'm right or wrong I'll die of curiosity.—F.L.G., Birmingham, Mich.

Model Worker Puts in Bid For a Modern Locomotive

I RECENTLY had the good fortune to see a display of locomotive models made by Ernest Warther, of Dover, Ohio. There were sixteen in all, starting with the first attempt to make a railroad engine up to the present locomotives. One model was made of ebony, ivory, and pearl. Others were of walnut, ivory, and pearl. All were connected to one motor through a series of belts. Now I would like a locomotive model, not one, of course, with moving parts because that would require too much skill. As a sugges-

tion, I think a model of the Empire State Express would be nice. What do you other model workers think of this suggestion of mine?—J.W.D., Dolliver, Ia.

We've Got 'Em on Our List—The Pests That Should Be Missed

AN AIRPLANE left here the other day with 200 pounds of serum to combat an epidemic of sleeping sickness among horses in Maryland. This gives me a bright idea. If horses get sleeping sickness, why not other animals? Why can't science feed the germs to pests that ought to go to sleep? For instance, think of having tom-cats curled up asleep instead of yawning on the back fence! Think of having mosquitoes snoring instead of busy with their braces and bits! Think of having house-flies deep in dreamless slumber instead of making tracks across the chinaware! There's a mark for science to shoot at. You can make your own list of pests. And you probably will include nuts who write Our Readers' Say daffy letters like this, and that's oke with me.—C.R., Chicago, Ill.



See What He Means Or Do You Need More Light?

J.K.G. of Tallahassee, Fla., at least has original ideas concerning light; however, they are not entirely correct. Light is a form of radiant energy traveling through the ether at a high rate of speed in the form of waves, it is believed. When a molecule has an excessive amount of energy things happen inside and some energy is radiated in the form of electromagnetic waves of various frequencies. When waves of a certain frequency strike the retina the sensation of light occurs. Now when, for instance, an electric light is turned on, the molecules of the filament get more energy, the filament becomes hot, and light waves are given off. These waves strike the retina and the sensation of light is experienced. When the light is turned off, the filament ceases to radiate these waves and no more reach the retina with the result that the sensation of light is no longer apparent. The waves radiated by the filament during the time it was hot do not disappear but continue to travel through the ether until they strike something which either reflects or absorbs them.—M.H., Saint Paul, Minn.

Try This Some Rainy Day When You're All Alone at Home

MAYBE you've heard this before; I just discovered it. Anyway, no kidding, there's a town in Wales with the awe-inspiring name of Llanfairpwllgwyngyllgogerychwyrndrobwlantysiliogogoch. It has a railroad station, and when the train conductor calls the stop he clips it to a prosaic "Llanfair." For fifty years this butchering of their town's fair name has irked the proud Welsh inhabitants, and recently they decided to do something about it. They emblazoned the name in full on a banner twenty-five feet long and hung it beside the station so that folks at least could see what it really was, even if they never could pronounce it. Fancy, telling anyone you were going there for the week end! There may be a longer name in the world somewhere, but I can't quite imagine it.—E.F.K., Elmira, N. Y.

BUT I TELL YOU WE WERE PAST BEFORE I GOT THRU CALLING IT!



What . . .

DO YOU WANT MOST IN YOUR NEXT CAR?

General Motors invites you to step out of the driver's seat and up to the engineer's desk—to tell us the kind of automobile *you* would build—the features you want most in *your* next car.

During the past year General Motors, through its Customer Research Staff, has invited well over 1,000,000 motorists "to pool their practical driving experience with the technical skill of General Motors Engineers and Production Experts."

In case you have not received our questionnaire "*The Proving Ground of Public Opinion*," we shall be glad to mail you a copy. *

It contains 24 pages of interesting information on important automotive developments during the past five years, and gives you the opportunity to "cast your vote" on the future trend of design.

GENERAL MOTORS

CHEVROLET • PONTIAC • OLDSMOBILE • BUICK
LA SALLE • CADILLAC • BODIES BY FISHER
GMC TRUCKS • FRIGIDAIRE

Send for **FREE** Copy

CUSTOMER RESEARCH STAFF
GENERAL MOTORS, DETROIT, MICH.

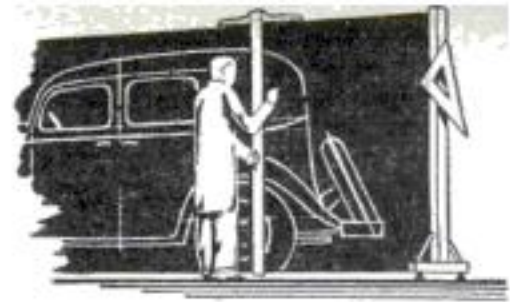
Please send me, without obligation, a copy of your questionnaire "*The Proving Ground of Public Opinion*."

Name _____

Street _____

City _____ State _____

(There will be no sales follow-up)



CHECK ☒ ANSWER

NO DRAFT VENTILATION



The passenger beside the ventilator enjoys fresh air without drafts swirling across the whole seat. Smoke and used air are instantly drawn outside by the vacuum set up at rear edge of ventilator.

Does your PRESENT CAR have this feature?

☐ YES

SYNCHRO-MESH TRANSMISSION



Prevents clashing of gears.
Makes gear shifting easy
and smooth. *

Does your PRESENT CAR have this feature?

☐ NO

AUTOMATIC CHOKE

- eliminates "choke" button on dash.
When engine is cold the gasoline
mixture is enriched automatically.
As engine warms up the choking
mechanism shuts itself off.



Does your PRESENT CAR have this feature?

☐ YES

STARTERATOR

STARTER BUTTON COMBINED WITH
FOOT ACCELERATOR



Engine is started by merely pressing
accelerator. If the engine stalls it
is automatically restarted by merely
pressing down on accelerator pedal. *

Does your PRESENT CAR have this feature?

☐ YES

☐ NO

Would you want it on your NEXT CAR?

☐ YES

☐ NO

☐ DON'T
CARE



* This booklet covers 67 features of motor car design relating to dependability, economy, performance, safety, comfort, convenience, appearance, etc.—as per specimens illustrated above.



POPULAR SCIENCE MONTHLY

December 1933

Vol. 123, No. 6

RAYMOND J. BROWN, Editor



Doctors Face Death TRAILING *Living* *Poisons*



Parrot fever
studied by a
scientist of
the Rockefeller
Institute

of MYSTERY DISEASES



White mice by the hundreds give up their lives to aid the fight on the deadly parrot fever. Each of them is inoculated with the material suspected of carrying virus and kept in a jar so development of symptoms is seen

By
**STERLING
GLEASON**

ACTING as human guinea pigs in the war on a mysterious disease, three courageous scientists are now working in an isolated laboratory of the United States Public Health Service. Deliberately they have exposed themselves to the bites of mosquitoes suspected of carrying epidemic sleeping sickness (encephalitis) which, at this writing, has gripped nearly a thousand persons in St. Louis. If, as they believe, these insects carry the deadly virus, they will contract a malady for which medical science has no sure remedy.

Whether the three brave experimenters recover and learn the secret of the dread disease, or succumb to a heroic death, the fight they are waging will go on. It is but one phase of a war today being fought on many fronts.

Like sheeted ghosts these masked experimenters work quietly in isolated laboratories, risking death dozens of times daily while handling germs and viruses. When baffling diseases sweep the country in terrifying epidemics, they become leaders of a medical army, military in its stern efficiency and its demand that every member be ready to lay down his life for the cause.

In this warfare, the latest scientific methods of the bacteriologist are weapons. Miniature epidemics, produced in the laboratory, rage for months while workers study symptoms and cures. Germs pass through countless generations in the test tube, live for years in the refrigerator while new races are bred and studied. Black-light microscopes are used to photo-





Material causing psittacosis, or parrot's disease, is whirled in this centrifuge to separate the solid matter in preparation for filtering process

graph organisms so tiny that for years they have escaped detection.

Such were the methods used in the study of other plagues when the recent sleeping-sickness epidemic broke out. It found medical science without specific means of checking it, for although epidemic encephalitis, one of several forms of the deadly sleeping sickness, has been known to man for 221 years, its germs have never been identified. It is one of a group of diseases caused by filterable viruses—poisons containing either chemical substances of prodigious destructive potency, or else living organisms so minute that they pass through filters that hold back ordinary germs, and are invisible even under the most powerful microscopes.

An alert pathologist detected the existence of encephalitis in St. Louis last July. Authorities, on the watch for additional cases, found an epidemic already in progress. New patients were sent to isolation hospitals and in the medical world, virtual martial law was declared.

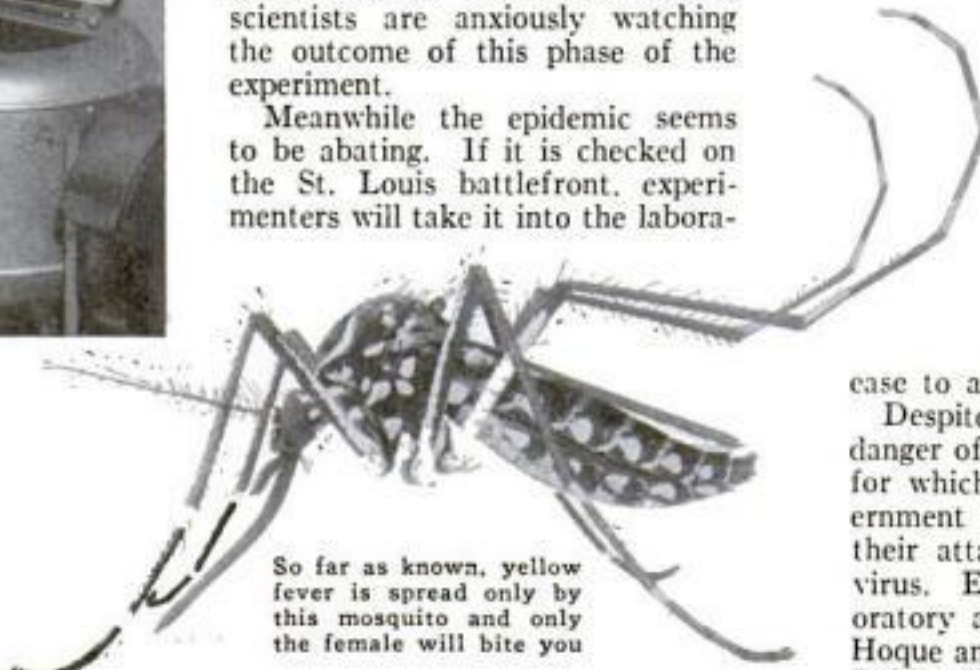
Dr. J. P. Leake, senior surgeon of the U. S. Public Health Service, arrived on the scene. At once he recruited a force of health officers, trained investigators, physicians, nurses, bacteriologists, and laboratory technicians. By long distance telephone he got authority from Washington to purchase monkeys, to be inoculated in the hope of developing a protective serum.

Meanwhile, his medical army studied the history of every case and analyzed sources of milk, water, and food, in an effort to find common avenues of infection. He was joined by Dr. Charles L. L. Williams, Jr., noted authority on disease-bearing insects. The sickness was found

eleven times more prevalent in the suburbs. This fact led him to focus attention upon possible insect carriers, especially those with a proboscis like a hypodermic needle, peculiarly fitted to plunge the virus directly into the bloodstream. These included the mosquito and certain biting flies.

Efforts to induce the disease in monkeys did not bring the hoped-for results. A human subject was needed. Without hesitation, three scientists volunteered and submitted themselves to the stings of mosquitoes that had bitten victims of the disease. As this is written, scientists are anxiously watching the outcome of this phase of the experiment.

Meanwhile the epidemic seems to be abating. If it is checked on the St. Louis battlefront, experimenters will take it into the labora-



So far as known, yellow fever is spread only by this mosquito and only the female will bite you

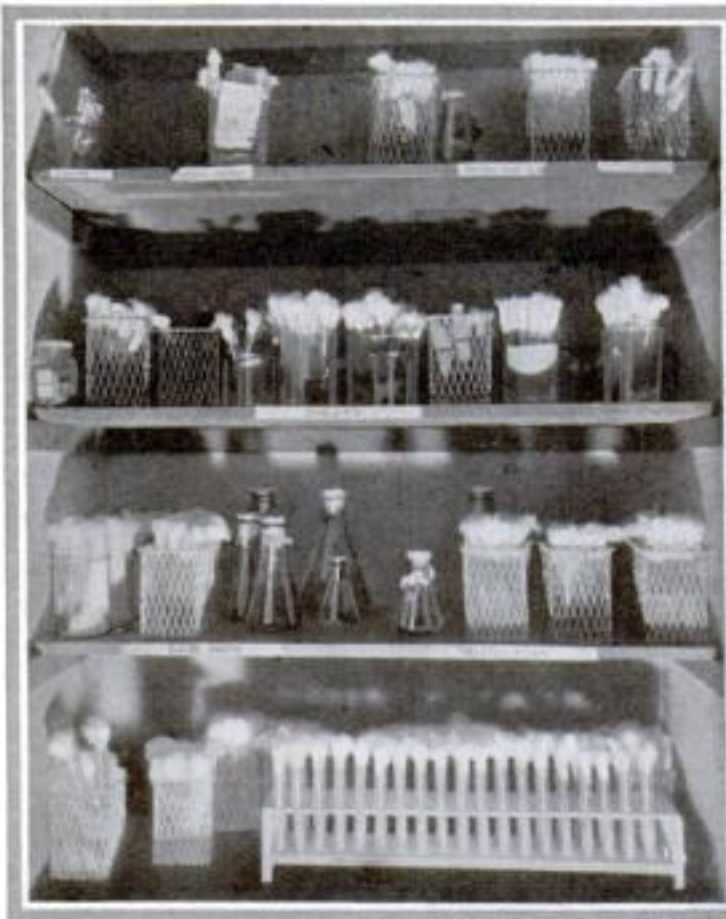
tory, where they will breed the deadly virus for further study. Here they will infect a guinea pig, rabbit, or mouse with the disease. Upon the animal's death, the brain and spinal cord will be removed, ground up, added to a salt solution, and injected into another animal to perpetuate the epidemic.

Unlike ordinary germs, which can be raised in the incubator for many generations on a little beef broth, the virus ordinarily grows only in living tissue. So small are its organisms or active bodies that the microscope shows nothing of their nature. Dissolving infectious material in a test tube, bacteriologists pump the cloudy solution through a Berkefeld filter—a candle of diatomaceous earth whose pores are so fine they hold back ordinary germs. They obtain a clear, colorless liquid, which under the microscope seems devoid of life. Yet a single drop of this clear fluid has the power of transmitting the disease to animals or men.

Despite their elusiveness and the danger of contracting terrible diseases for which science has no cure, government research workers continue their attack upon the riddle of the virus. Even now, in a secluded laboratory at Pasadena, Calif., Dr. V. M. Hoque and other workers of the U. S. Public Health Service are conducting experiments with psittacosis, the mysterious parrot disease that spreads to man so rapidly that it is classed as one of the most highly contagious diseases known.

At the Hooper Foundation, the University of California's research laboratory at San Francisco, similar studies are in progress, as well as at the Rockefeller Institute for Medical Research in New York. So hazardous are they that Dr. Karl F. Meyer, head of the Hooper Foundation, will allow only himself and one assistant to perform work involving actual contact with the birds—even though the assistants flirt with death-dealing germs dozens of times daily in their ordinary work.

The study is a continuation of a courageous battle begun in 1929,



Food for every known kind of bacteria is kept in test tubes like those shown above. Great care is taken to find the media in which the bacteria grow best. At right, in studying parrot fever, many bacteria that have no relation to that disease are found. Here the technician is moving bacteria cultures



when a mysterious epidemic flared across the nation. Simultaneously it sprang up in Paris and other parts of Europe. Symptom of the disease was a fever combined with a lung infection so similar to pneumonia that physicians found it difficult to distinguish it until death had claimed the victim.

Identification of the malady as the deadly parrot disease of the tropics came about purely through chance. An American doctor read about an opera troupe in Argentina, attacked by a strange disease after a performance in which parrots were used. Next day, he happened to notice a sick parrot in the homes of two patients whose ailment he had not been able to diagnose. Scientists traced the malady at once to infected parrots and parrakeets recently imported from South America. Outbreak of the disease in sixteen foreign countries signalled the appearance of a world-wide epidemic.

War immediately was launched against the dread disease in five great laboratories. The highly contagious nature immediately appeared. Sick parrots, brought into the Public Health Service laboratory for study, caused an epidemic in which eleven laboratory workers were stricken, one fatally.

Though they worked in isolated, insect-tight, thoroughly disinfected laboratories, and wore sterilized masks and surgeons' rubber gloves, experimenters became infected with the malady. Infection came through the nose and throat, when workers breathed virus-laden dust particles from the parrots and their cages—a form of exposure almost impossible to control. But these misfortunes, in the simple words of Surgeon-General Hugh S. Cumming, of the Public Health Service, "only served as an additional incentive to our work."

Shocked by the spread of the epidemic, the Government imposed a stringent quarantine on all impor-



This Berkefeld filter is so fine ordinary bacteria can not pass

tations of parrots. France and a number of other countries imposed similar embargoes. Private owners, terrified, killed their parrots wholesale. The disease attracted wide publicity when the wife of Senator Borah, of Idaho, contracted it. From their laboratories in Washington, government scientists directed her treatment by telegraph. Meanwhile, Dr. H. E. Haseltine and Dr. Charles Armstrong, distinguished scientists who were themselves recovering from a laboratory infection of psittacosis, gave their blood for a serum. An airplane rushed to Idaho with the precious fluid in time to aid her in a successful fight against the malady.

Once the movement of parrots had been checked by law, the epidemic burned itself out. It flared up again when California, a focal point of the disease, lifted its quarantine and permitted owners of avaries to ship their birds. Im-

mediately fifty new cases, due to California-bred birds, were reported from all parts of the East. The Federal government thereupon permanently prohibited all interstate movement of the birds, except under specific permission of state authorities.

Research for a remedy or immunizing serum is still going on throughout the

world. It has been found that chickens as well parrakeets, canaries, and love birds—may contract the disease.

Still another deadly disease linked to a filterable virus is poliomyelitis, better known as infantile paralysis, although persons of all ages may contract it. It leaves its victims crippled for life. Like psittacosis, it, too, is a mystery disease—another of the many sinister diseases that come to man in an unknown manner out of the vast disease reservoir of the animal kingdom.

When an epidemic of this terrible paralysis broke out in southern California two years ago and began to spread northward through the state, scientists of the Hooper Foundation went into action. Beatrice Howitt, research worker, aided by Dr. H. E. Thelander and Dr. Edmund Shaw, of the Children's Hospital, advertised widely for blood from persons who had recovered from the disease. Then she travelled over the state, collecting the blood, which she sterilized and pooled, five or six samples to a group.

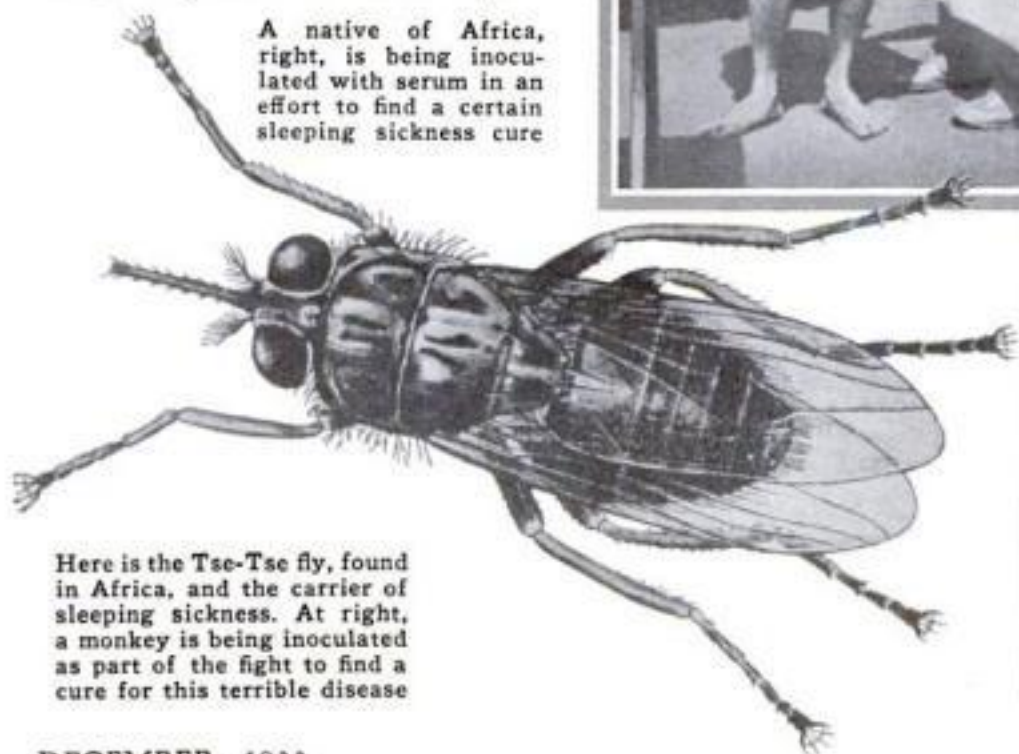
This blood was then given to victims of the disease, fifty cubic centimeters at a time. Such blood contains natural antibodies which counteract the virus, and is the only known substance of value in the treatment of the paralysis. More than 140,000 cubic centimeters of the serum were used during another recent epidemic in New York, where 6,000 persons contracted the disease.

When signs of an epidemic appeared in San Luis Obispo, Calif., the local health officer determined to prevent it from gaining a foothold in his city. Going from house to house, he and his workers visited every home, examining each person that was unwell. More than a hundred cases were discovered, many of them in a mild form that otherwise might have gone undetected until too late. Serum was given immediately. As a result, there were no deaths, although elsewhere the disease took toll of many lives.

Knowledge of the mysterious poliomyelitis organism was recently advanced by Dr. Frederick Eberson, of San Francisco, who successfully grew the virus outside the body. The original virus, diluted a million times, was transplanted to a new medium, where it grew and reproduced steadily. Apparently the virus bodies have a *(Continued on page 102)*



A native of Africa, right, is being inoculated with serum in an effort to find a certain sleeping sickness cure



Here is the Tse-Tse fly, found in Africa, and the carrier of sleeping sickness. At right, a monkey is being inoculated as part of the fight to find a cure for this terrible disease

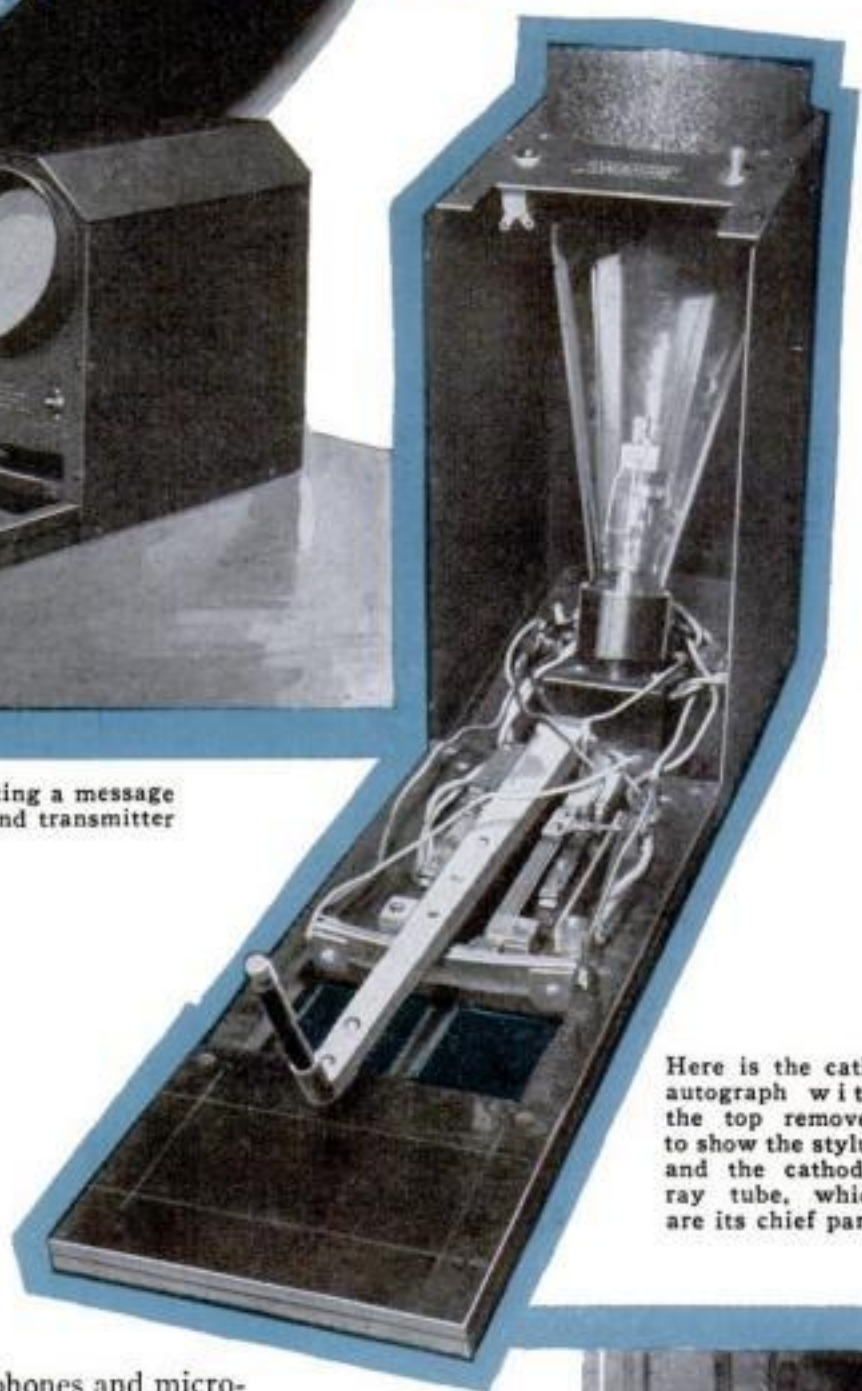


RADIO PEN

*writes in letters of fire
on far-away screen*



Allen B. DuMont, inventor of the radio pen, called a cathautograph, is writing a message with his remarkable device. The instrument shown here is both receiver and transmitter



Here is the cathautograph with the top removed to show the stylus and the cathode-ray tube, which are its chief parts

SWEEPING across a mysterious screen like an invisible pencil, a beam of electrons recently penned the message of welcome that opened the National Electrical and Radio Exposition in New York City.

Seated before a small black box, Clarence L. Law, president of the New York Electrical Association, wrote his official greeting with a pencil-shaped stylus. Simultaneously, in a far corner of the exposition hall, the words of his message flashed across a screen in glowing script. As though guided by some unseen hand, a weird green spot traced out the luminous letters of fire just as they were written.

This was the first public demonstration of the latest wonder of science—the cathode-ray pen.

Called the “cathautograph” by its inventor, Allen B. DuMont, of Montclair, N. J., this new instrument promises to add another important chapter to the story of communication. Sending messages that can be read rather than heard, it opens new fields for the telephone and the radio. Where earphones and loudspeakers bring code and speech, the cathautograph can bring the written word in any language.

The fact that anyone who can read and write can operate the cathautograph makes it particularly valuable in radio. In emergencies on the high seas, for instance, ships equipped with electric pens would

not need the constant services of trained operators for their radios. The captain, the mate, or even the cabin boy could scribble a message of distress and receive instructions.

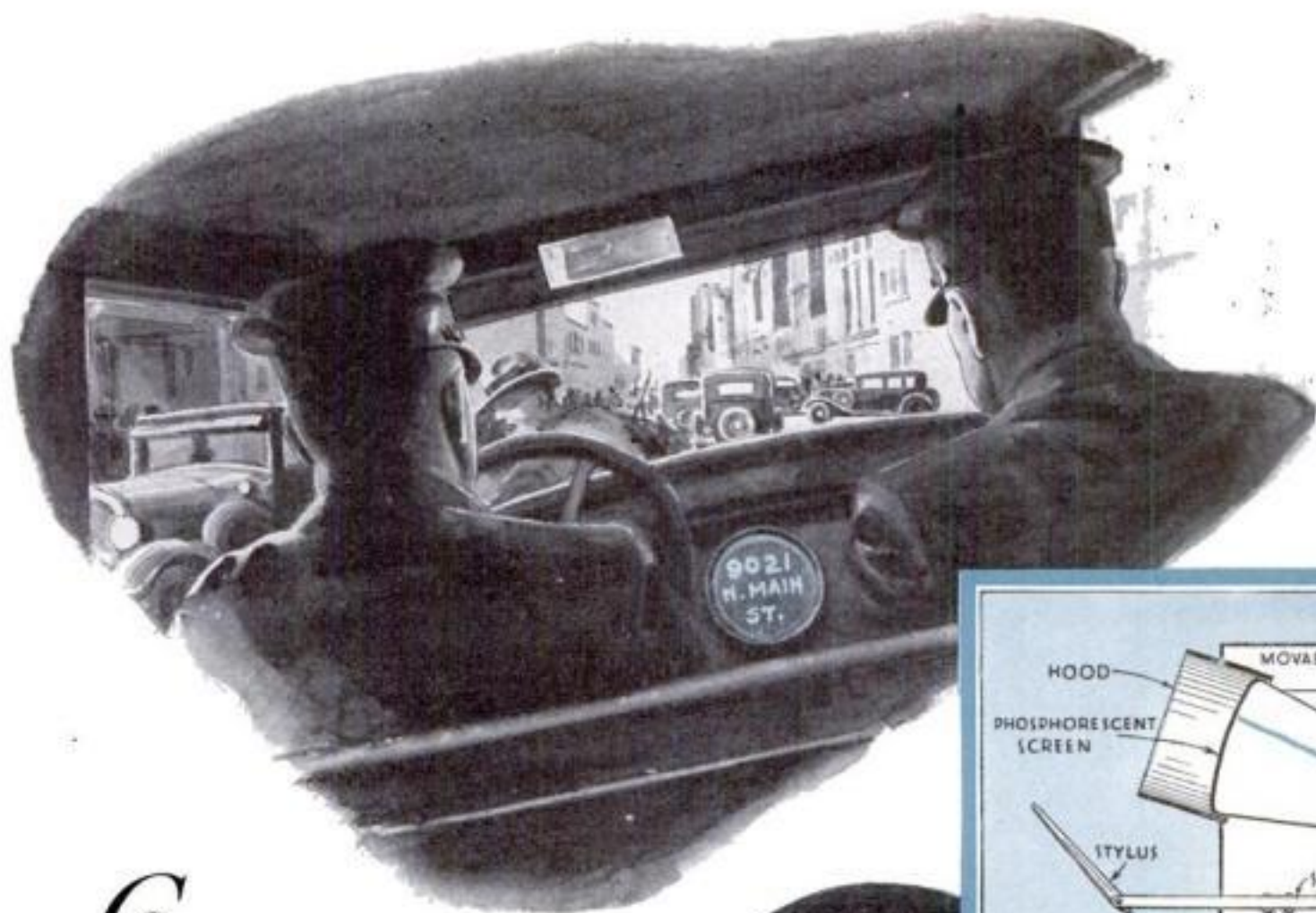
In other fields, the cathautograph meets similar needs. In airplanes, it can be used to replace with its pencil-shaped stylus, the present cumbersome earphones and microphones. Visual communication can be carried on between large transports and land stations and maps, as well as instructions, can be sent and received.

To the radio police, it offers a means of transmitting diagrams as well as written messages to outlying districts and speeding squad cars. In business, it can provide interoffice communication. To the stock broker it furnishes a quick, accurate means of sending and receiving stock quotations and trading orders.

Physically, the cathautograph receiver is simply a special type of cathode-ray tube having a phosphorescent, instead of a fluorescent, screen or target. Like the kinescope of television (P.S.M., Sept. '33, p. 11), it depends on an easily deflected beam of invisible electrons. Speeding be-



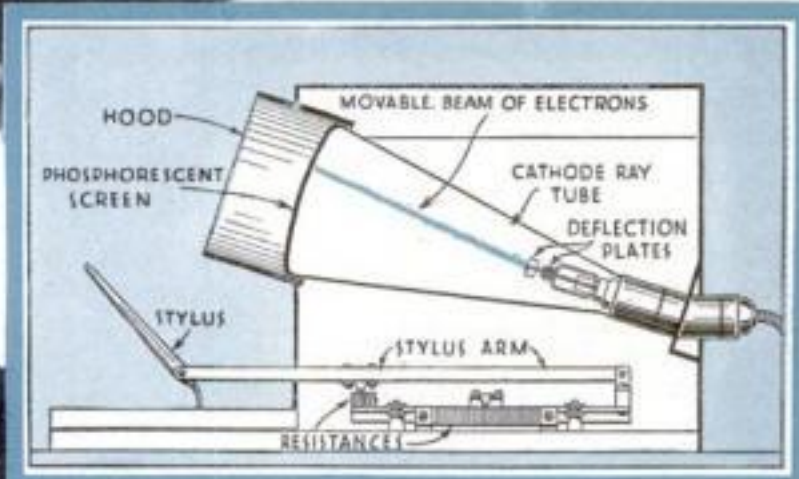
Transmitting written market quotations is one of the uses to which cathautograph may be put



By
**GEORGE H.
WALTZ, JR.**

With the cathautograph installed in radio police cars, silent messages could be sent to and from the police officers

*CATHODE-RAY tube,
having a phosphorescent screen,
makes it possible to broadcast to
a distance messages that can be
read as fast as written*



Sectional view, above, shows clearly how the cathautograph transmitter and receiver are operated. At left, photograph showing appearance of words on phosphorescent screen



tween two sets of metal plates in the base of the tube, this beam can be bent up, down, or to either side merely by varying the voltage on the plates.

At the transmitter, the pencil-shaped stylus is supported on a movable arm. By means of an ingenious sliding pivot, the arm and stylus can be moved in any direction to form even the most complicated letters and figures.

When the stylus is moved in writing a message, sliding contacts on the arm glide over two coiled-wire resistances connected

electrically to the two sets of deflecting plates in the tube of the cathautograph. Being arranged at right angles to each other, each resistance is controlled by the movements of the stylus, one by vertical motions, the other by the horizontal.

As each resistance is made shorter or longer depending on the position of the stylus, more or less electricity can pass to the corresponding deflection plates enclosing the beam of electrons in the tube. Since the deflection of the beam one way or the other depends on the voltage of these plates, its motion is identical with that of the stylus.

Speeding through the neck of the tube, this beam then strikes the special phosphorescent screen of the cathautograph. As the electrons in the beam bombard the screen, a glowing spot appears and as this moves it leaves a fiery trail of phosphorescent lines and letters.

In the present model some ten words can be seen on the screen before the glow of the first line begins to fade. As the eleventh word is written, the first word disappears and a new word can be written in its place. However, by altering the design of the screen the inventor claims that it can be made to hold its glow even longer.

Inspecting one end of a simple two-way cathautograph system of the wired type, you would notice that the combined receiver and transmitter closely resemble a theatrical spotlight. At the top, mounted like the spotlight lens, you would find the

phosphorescent screen of the cathode-ray tube receiver. Below this, projecting forward, you would notice the writing stylus and the movable arm.

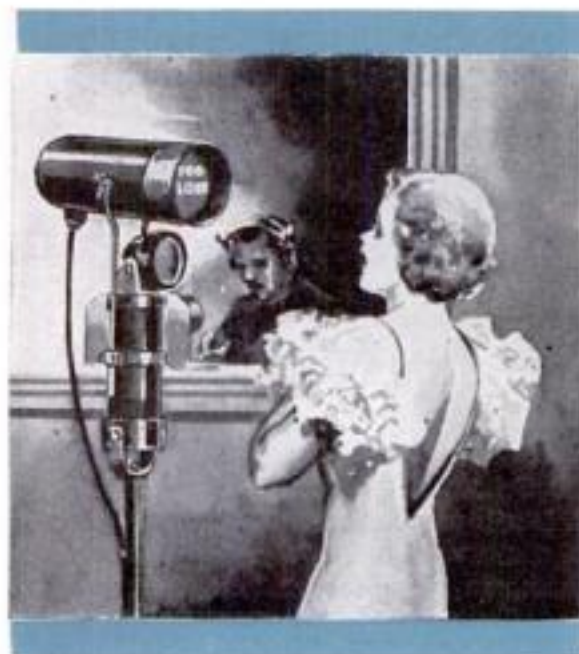
To write a message, you would instinctively pull the stylus toward you to place it in a normal writing position. This would operate an automatic call signal at the distant receiver. At the same time, a brilliant green spot would appear on your screen and a similar spot also would glow on the screen of the second instrument.

Using the stylus just as you would a pen or pencil, you would write the first word of your message. So free would be the motion of the stylus that you could write in your natural hand.

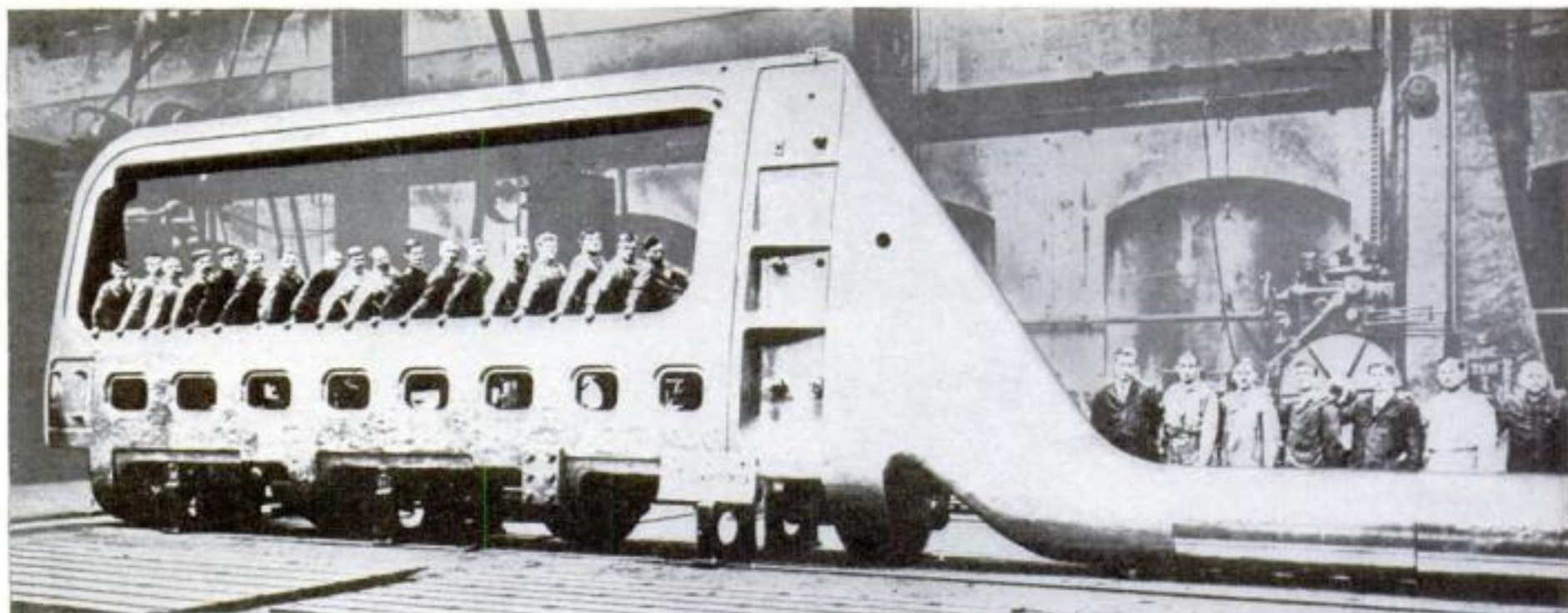
Following the movements of the stylus like a magic ball of fire, the green spot of light on the distant screen, as well as the one on your own, would trace out each letter just as it was formed. When you would lift your stylus at the end of each word, the glowing spot would disappear only to reappear again some distance away when the stylus was lowered at the beginning of another word.

As the stylus at the other transmitter would be moved in penning the reply, the glowing spot on your screen would slowly and deliberately trace out letters, words, and sentences in glowing script. In time, its luminous trail would fade and new words would appear. Finally, the script would stop and the red light on your receiver panel would go out, telling you that the message was finished.

The New York demonstration of the cathautograph marked the end of a long series of experiments. Now, its inventor is working on a method of making a permanent record of the luminous writing.



In the broadcast studio, the cathautograph can be used to give entertainer written directions



FIFTY-SIX-FOOT RUDDER FOR WORLD'S BIGGEST LINER.

JUST equipped with its giant rudder, the *S. S. Normandie*, biggest ocean liner in the world, is nearing completion in a French shipyard for its maiden voyage next spring. Some idea of the vessel's staggering dimen-

sions is given by this fitting alone, shown above, which measures fifty-six feet in length and towers high above the workmen standing upon it. The view was made before the addition of sheathing that gives

the rudder an unbroken, streamline surface. The mighty *Normandie*, first transatlantic vessel to be fully electrified (P.S.M., Oct. '33, p. 16) is powered by the four largest motors ever built.



HOTEL BUILDS MONUMENT OF BROKEN CHINA

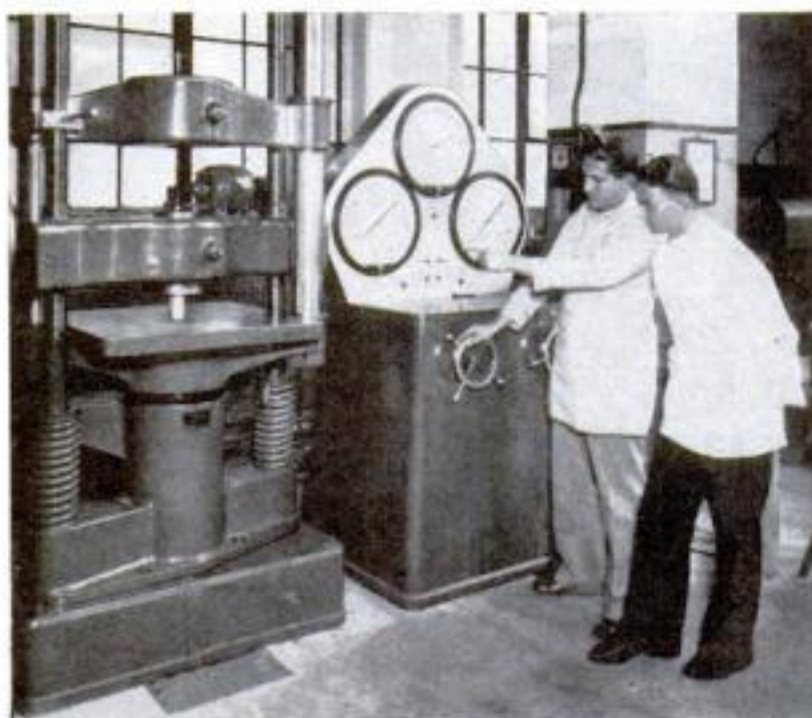
BY CONSTRUCTING a monument of all its broken crockery, a hotel at Hildenborough, England, has provided its grounds with an unusual landmark. The pile of china fragments serves as a gentle admonition to careless guests and attendants, inviting them to refrain from adding to its height. In spite of this warning, however, the monument to carelessness continues to rise and is now nearly as high as a woman's head, as is seen in the illustration at left.

BIGGEST BIRD MORE THAN 14 FEET TALL

BONES of a bird that scientists believe the biggest that ever lived have been unearthed by a museum expedition at Cuddie Springs, Australia. In life the bird is thought to have resembled an emu; but its size must have surpassed that of the moa, an extinct, flightless bird of Australia and New Zealand, which stood fourteen feet high.

BIG MOUTH TESTS DENTAL FILLING

TO LEARN how to make dental fillings so strong that they may be bitten upon without damage, samples of various materials are being compared in an unusual series of tests at the United States Bureau of Standards. The specimens are placed in a mechanical mouth that bites down upon them. Dials then register the pressure at which each one breaks. Results of the tests are being observed and carefully studied by experts of the Georgetown University Dental School.



Power machine gages pressure needed to break dental fillings



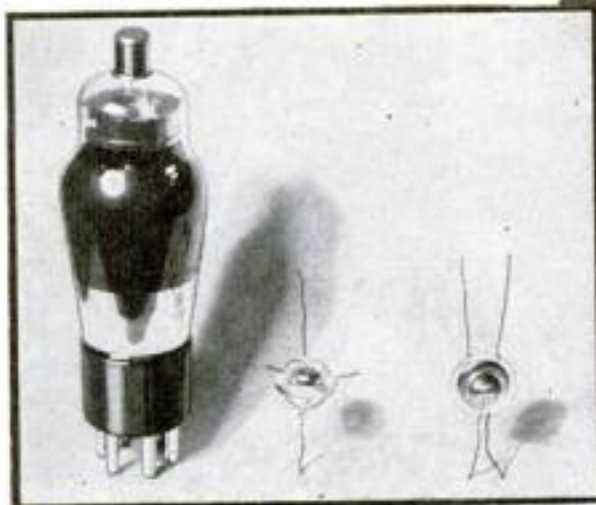
USE SWINGING SCAFFOLD TO SET MARBLE COLUMN

SETTING marble columns in place is made easier by an innovation in building methods, in which the workers and their scaffold are hoisted along with a section of stone that is to be added to the column. When the section is lowered in place, the men are within easy reach of the joint, as shown in the photograph above. The new procedure saves the expense of constructing scaffolding around each column, since the small temporary scaffold is swung from one job to another.

Use Tiniest Radio Tubes in Ultra-Short Wave Study

RADIO tubes that look like toy marbles, believed to be the smallest ever built, are aiding experiments designed to solve the problems of communication on ultra-short waves. Their working parts are assembled in a space no larger than a pea, and a receiving set employing the new tubes fits comfortably in the palm of the hand. The tubes permit the reception of radio waves only a foot in length, thus opening a range of potential radio channels many times as wide as the regular broadcast band. Their development by engineers of the RCA Radiotron Company is regarded as bringing nearer the commercial use of these channels, despite the fact that much experimental work on methods of transmitting ultra-short waves from the sending station to receivers still remains to be done. It is this work that the experimenters are now doing.

At right, transmitter and receiver used in ultra-short wave experiments. Below, two of the tiny tubes for short-wave use compared with a standard tube

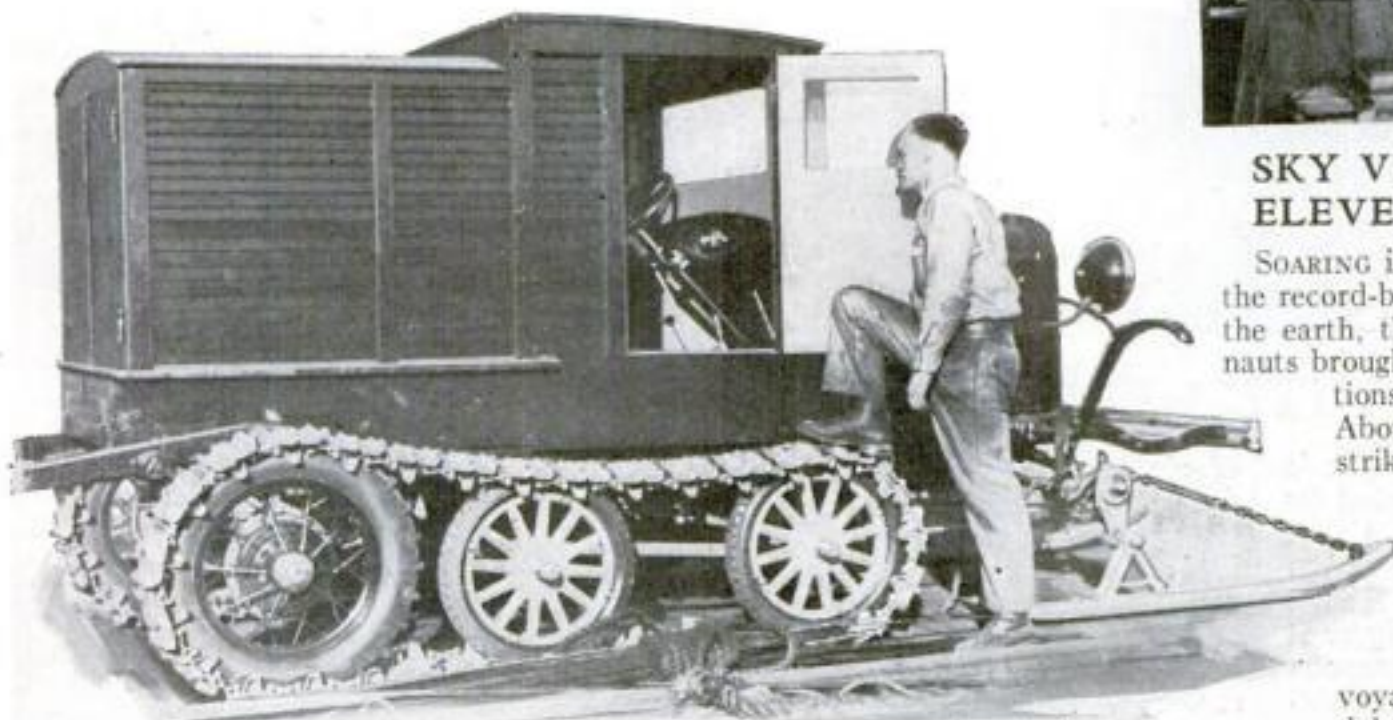


THERMOSTAT FOR CARBURETOR

INSTALLED on any car, with only a wrench and pliers for tools, a new thermostatic device automatically adjusts the carburetor mixture to suit the weather and the engine temperature. The thermostatic element, resting on the exhaust manifold, closes an air valve when the motor is cold and opens it, making the mixture leaner, as the motor warms up.

SNOWMOBILE FOR POLAR TRIP

MEMBERS of Rear Admiral Richard E. Byrd's second expedition to the Antarctic, which recently started for the South, will whiz over the polar ice and snow in a curious six-wheeled vehicle nicknamed the "snowmobile." Its endless treads provide firm traction, no matter how bad the going, while a pair of ski runners at the front serve to steer the car.



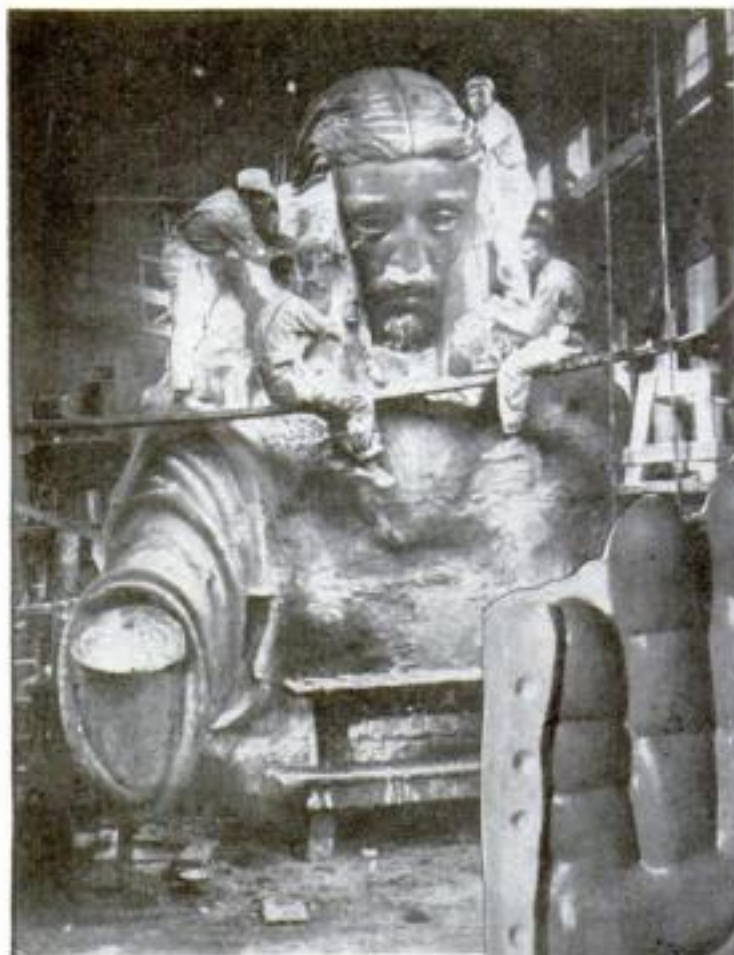
Six-wheeled snowmobile to be used by Rear Admiral Byrd on his present expedition to the Antarctic



SKY VIOLET IN COLOR AT ELEVEN-MILE ELEVATION

SOARING in their airtight balloon gondola to the record-breaking height of 11.8 miles above the earth, the other day, three Russian aeronauts brought back the first scientific observations ever made at so great an altitude. Above their heads the sky provided a striking spectacle; its color had turned to a soft, deep violet, almost devoid of the light-reflecting haze found at lower levels. Looking down, they tried in vain to detect any curvature of the earth's horizon. Following their successful voyage to the stratosphere, in the gondola illustrated above, still higher ascents are planned.

STATUE OF CHRIST THIRTY FEET TALL



THIRTY feet tall from head to base, a colossal statue of Christ is nearing completion in a Denver, Colo., workshop. When it is unveiled next spring atop a high mountain peak, the figure, largest of its kind in this country, will be visible for miles around. It will be composed of 200 blocks of terra cotta, so perfectly fitted that the joints will be virtually invisible a few feet away. When filled with concrete, the figure will weigh seventy-five

Thirty-foot statue of Christ, at left, will be unveiled on Colorado mountain top next spring. Below, one of its gigantic hands



tons, and a tower of steel has been erected on the site to support it. The design for the statue was copied from famous paintings.

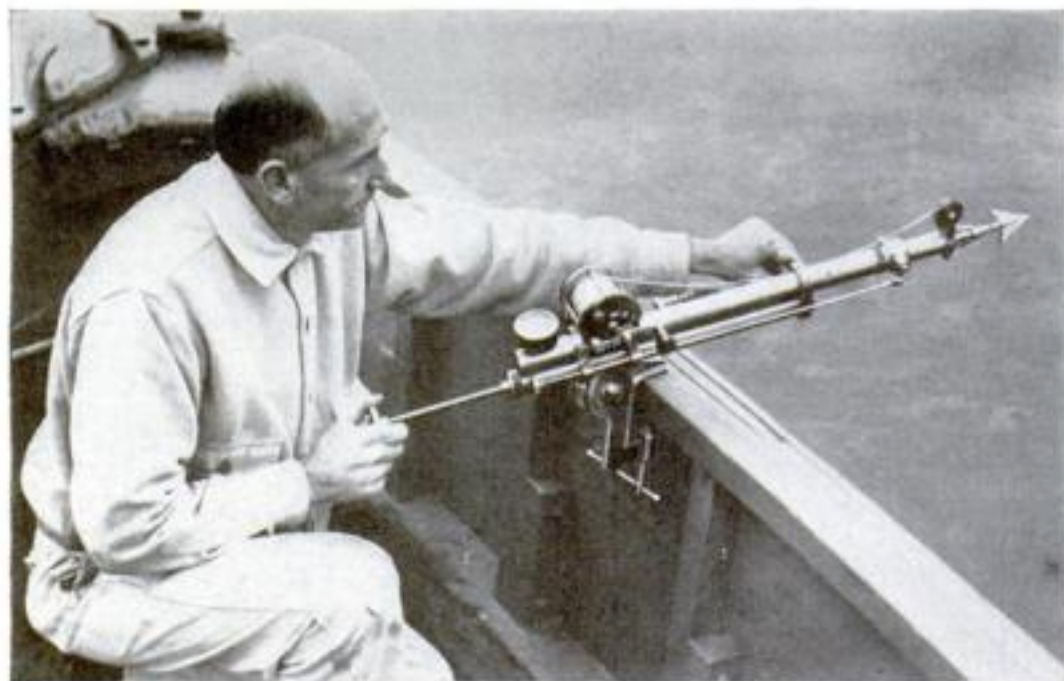


BIG FLASH-LIGHT BULB FOR PHOTOGRAPHERS

To fill the need of amateur and professional photographers for an electric flash bulb of greater brilliancy than those previously on the market, a new oversize bulb has been announced. Resembling a 300-watt incandescent bulb in size, it gives three and a half times as much light as the standard professional flash bulb, with which it is compared above. Since a small-sized flash bulb designed for home use has also been placed on the market recently, a range of three sizes is now available.

SAFE DRUG TAKES OFF TWO POUNDS A WEEK

DISCOVERY of a drug that enables overweight persons to reduce safely without exercise is reported to the American Medical Association by two California research workers. Experiments conducted by the discoverers, Dr. W. C. Cutting and M. L. Thayer of the Stanford Medical Laboratories, show that daily doses of the drug will remove two pounds of weight a week.



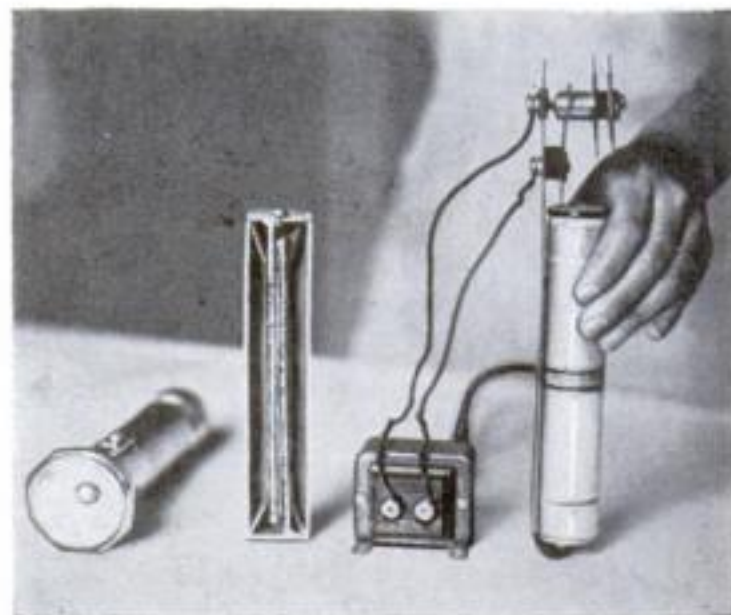
KILL SWORDFISH WITH NEW AIR GUN

HUNTING swordfish with an air gun is made possible by a weapon invented by C. R. Klein, of Santa Monica, Calif. Mounted on a boat with a swivel clamp, it may be elevated or lowered and sighted in any direction. When a hand trigger is pressed, compressed air fires the harpoon and 200 yards of line from the small one-and one-half inch barrel. A power compressor furnishes the 100-pound pressure

of air needed to operate the device. The air gun weighs only eight pounds, is virtually noiseless, and is said to be extremely accurate in operation. The power of the gun is so great that the harpoon is driven into the fish at a considerable distance and the harpoon holds so securely, the fish is easily killed.

RECHARGE FLASH-LIGHT BATTERY

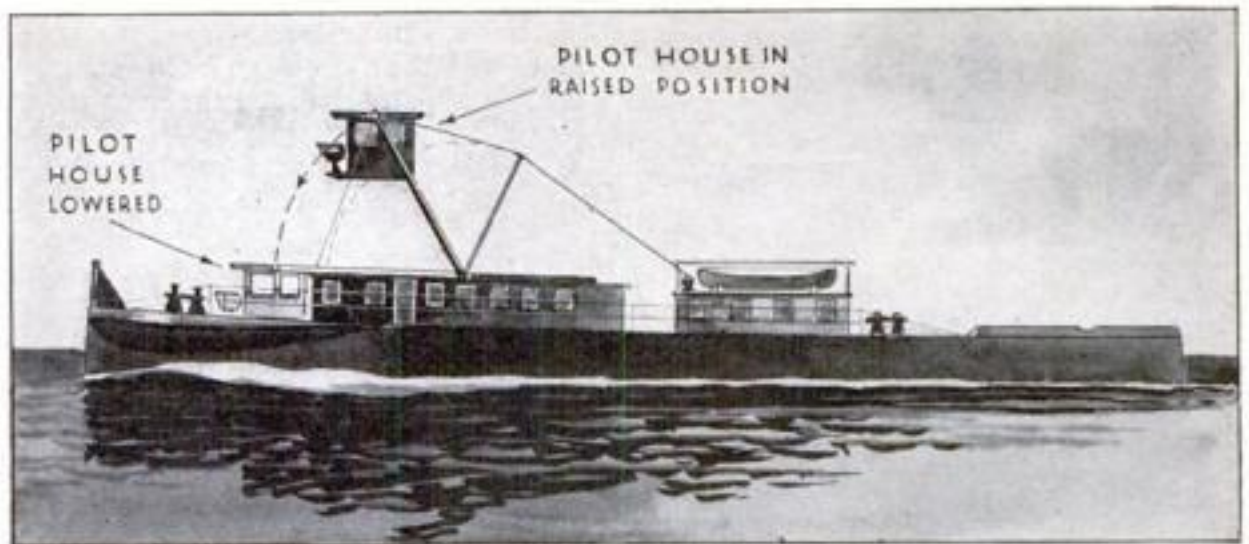
FITTING any standard case, a new type of flash-light battery may be recharged like a storage battery when it is used up, according to the Canadian inventor. Both the plates, and the moist jelly that serves as electrolyte, are hermetically sealed within an inner container of flexible rubber, which provides for expansion due to gas, and an outer shell of aluminum. The flash-light battery will give ten hours of useful service after each charging.



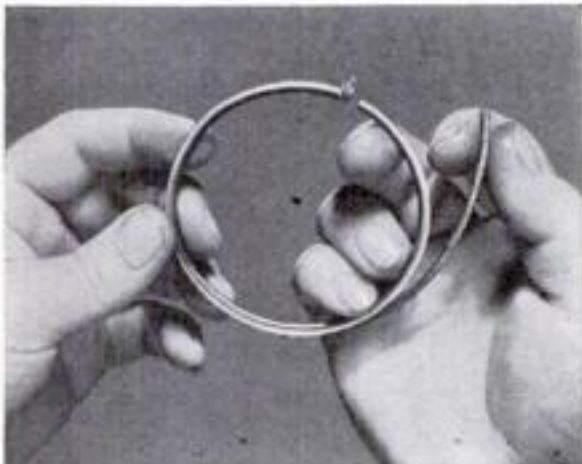
New rechargeable flash-light battery, right, and at left a cut-away view showing rubber container and aluminum shell

NEW TUG'S PILOT HOUSE CAN BE RAISED OR LOWERED

EQUIPPED with a movable pilot house that can be hoisted to a height of twenty-two feet above the waterline, or lowered to the main deck, one of the strangest of towboats is being built for service on the Chicago River. Its design gives the pilot the elevated point of vantage necessary for maneuvering a long string of barges, while providing for the fact that the vessel must pass under bridges where the clearance is only twelve feet. When a bridge is approached, cables will lower the pilot house, and a motor-driven hoist will raise it when the obstruction is passed. The 113-foot craft will be driven by a 550-horsepower Diesel engine and will have three rudders, one in the usual position and one on each side of the propeller shaft.



The illustration above shows the pilot house on a new towboat raised for observation purposes, while the dotted lines indicate how it is lowered to pass under low bridges



ASBESTOS PACKING NOW USED IN PISTON RINGS

ASBESTOS piston rings, declared by their designer to reduce wear upon the cylinder walls of a car's motor, are the invention of an Erie, Pa., automotive engineer. Each ring is made from a U-shaped strip of steel or bronze, the groove being filled with asbestos packing as shown above. The latter is braided with fine copper wire and impregnated with graphite. Rings of the new type are used as compression rings only.

DELIVERY CAR LED FROM DOOR TO DOOR

Just as a wagon driver leads his horse, so the operator of a new British delivery truck can lead it from door to door. The three-wheeled vehicle operates on storage batteries, and is steered either from the driver's seat or from outside by means of a swivel handle. An auxiliary speed-regulating handle just above the floorboard is also accessible from the exterior. Thus the grocery man or baker may lead his machine beside him, stopping at each house on a block, and then step aboard and drive away. The sixty-volt battery that powers the vehicle, will run it for thirty to thirty-five miles without being recharged, so that the truck is said to be very economical to operate and facilitates package delivery.

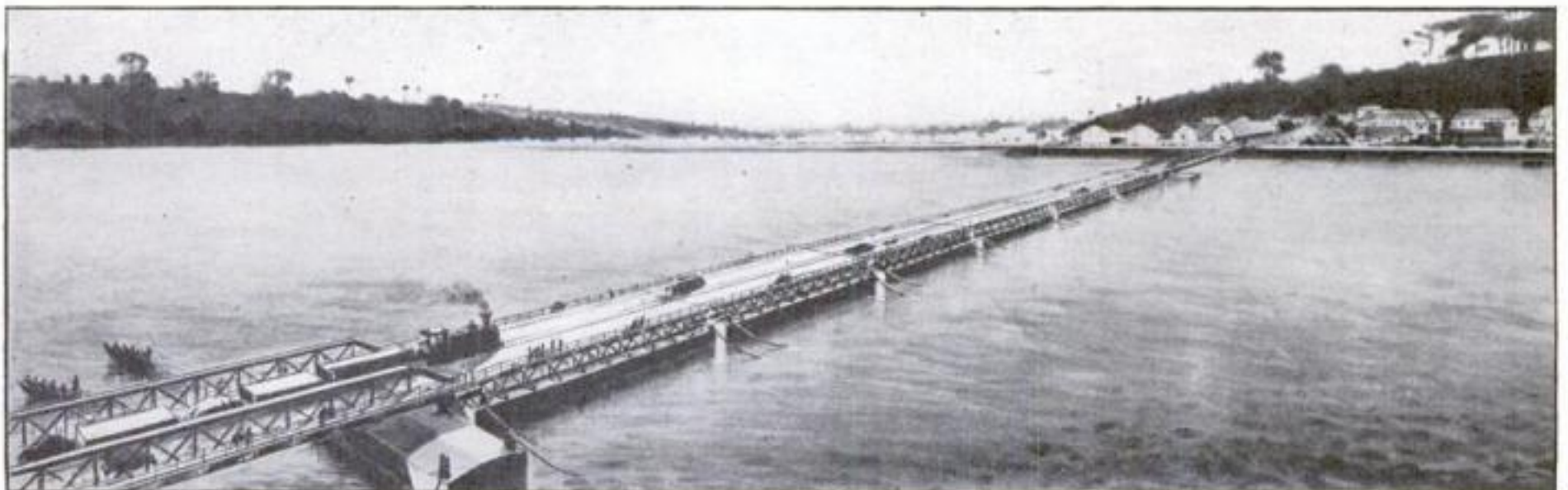


FLOATING RAILROAD BRIDGE RISES DURING HIGH WATER

FIRST of its kind in the world is a floating bridge constructed by daring engineers in French West Africa, to carry railway and automobile traffic across the quarter-mile-wide lagoon separating Port Bouet from the mainland. The floating part, 689 feet long, is built upon six steel pontoons, se-

curely anchored to concrete blocks sunk in the soft bottom. When the water is low, the bridge is level. During flood periods, however, water ballast is admitted to the pontoons in varying amounts so as to give the bridge a camel-back curvature. Ingenious hinges and joints at the ends of the

floating section permit the passage of cars and trains without hindrance, regardless of the position of the bridge. By this plan, the engineers spanned the lagoon at less than half the cost of a fixed bridge, which would have been expensive to erect on suitable foundations.



Bridge spanning lagoon in West Africa. It is so built that during high water the center section rises without interrupting traffic

BIG ACCORDION WORKED WITH PEDALS



Above, large accordion attached to frame so it can be played with pedals. Right, front removed to show how the piano keys operate instrument's air valves and reeds

TO PROVIDE musicians with a larger accordion than could be carried conveniently on a strap around the neck, a foot-pedal instrument of ingenious design has been devised and patented by Samuel Sater, New York City inventor. One of its two pedals expands the bellows; the other contracts it. The notes are pressed with the fingers upon a keyboard resembling that of a piano. Removing the front casing, however, reveals that each of the keys, when depressed, opens a valve that allows air from the bellows to pass over a corresponding set of reeds for that particular tone. Readily portable, the instrument is dismantled or set up again in a few minutes, the outer sections folding together to provide a case.

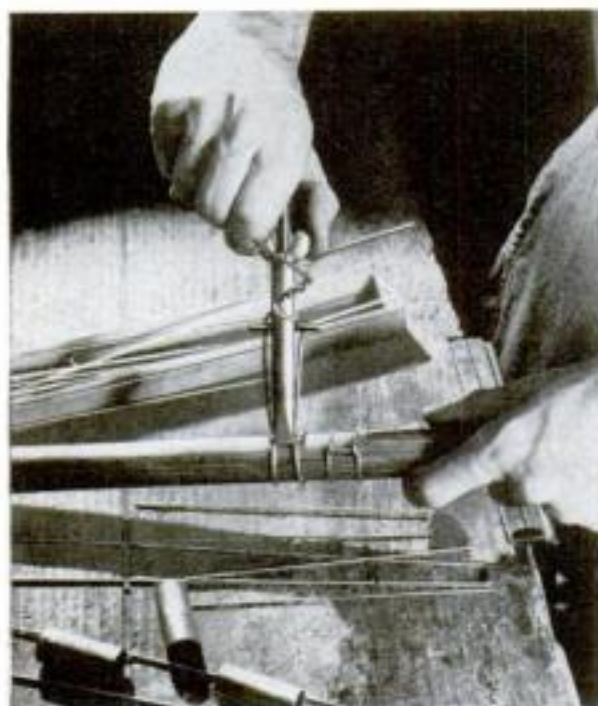


FOLDING STEREOSCOPE FOR AIR-MAP STUDY

SIMILAR in principle to the old-fashioned parlor stereoscope, an aviation stereoscope has been devised especially for the use of air-mapping companies. When two pictures, made from near-by points in the air, are placed side by side and examined with this device as shown above, the objects in the pictures appear to have depth and stand out in relief, making it easy to locate desired landmarks. While the instrument handles photographs as large as eight by ten inches, it folds into a compact case.

SPRING POWERS AUTO

AN AUTOMOBILE that runs by clockwork was produced recently by Japanese designers. Its spring motor is said to drive the car forty miles at one winding. Because of the simplicity of its construction, the machine can be sold at a fraction of the price of the average car.



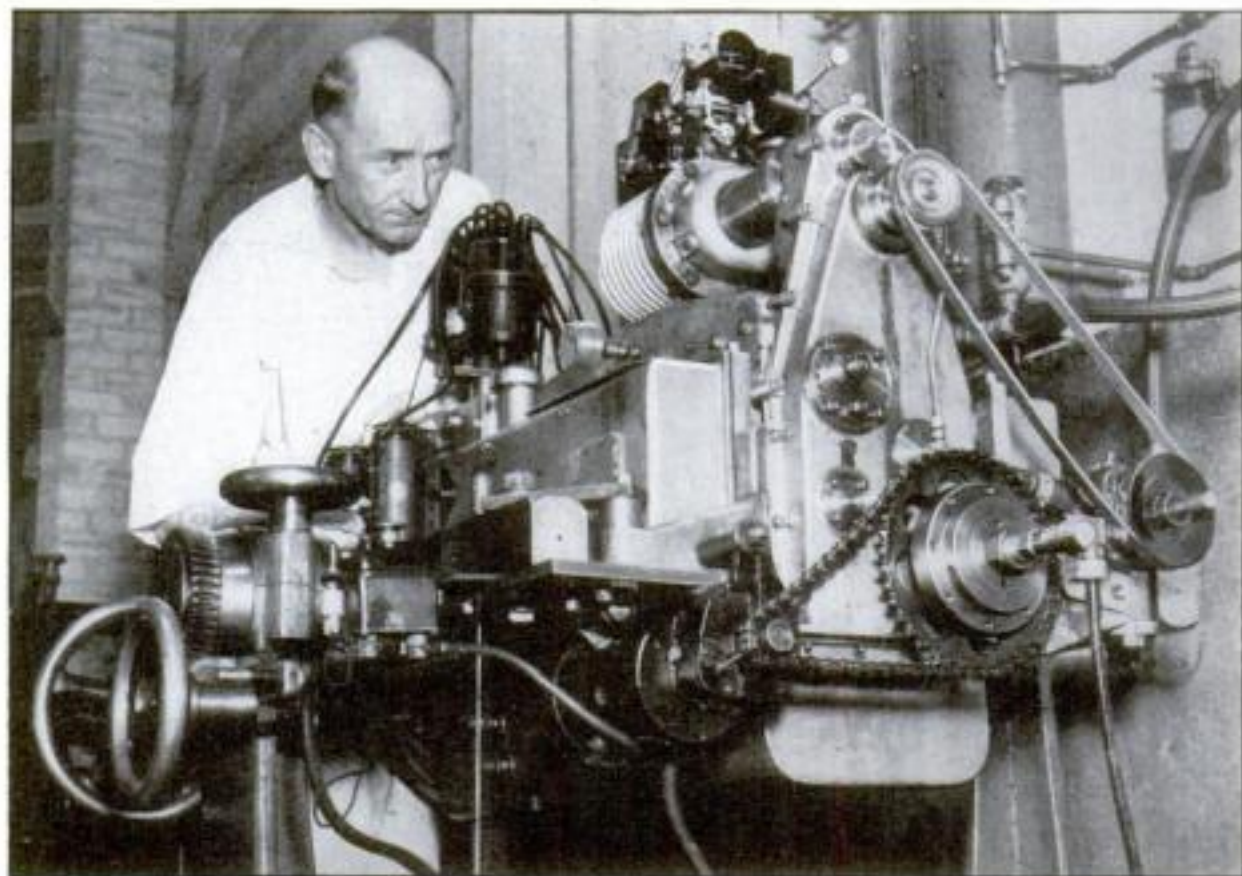
NEW TOOL PUTS WIRE BAND AROUND HOSE

APPLYING a wire band to a hose, broken tool handle, or other object is a simple operation with the aid of a new tightening device. The wire, bent into the shape of a "U" with square base and long sides, is wrapped around the object to be braced, the ends passing through the loop. The tightener is placed with its notched end resting against the loop while the ends are twisted together over a pin in a movable bolt. The wire is tightened by turning a wing nut on the bolt. The tool is then swung over so the wire is bent to form two hooks around the loop.

MOTOR HAS 8 CYLINDERS, 16 PISTONS

INTENDED especially for motor cars and airplanes, a gasoline motor of radical new type has been invented by C. R. Klein, of Santa Monica, Calif. Tests of a 268-horsepower, eight-cylinder model, with sixteen pistons, are reported to show the motor unusually free of vibration and

economical of fuel. Two pistons in each of the cylinders operate from opposite ends and compress the charge toward the center, where it is fired. Klein now plans to build a similar model of 1,100 horsepower, which, according to the inventor, will be suitable for a large transport plane.



Model of an eight-cylinder gasoline motor, that has sixteen pistons and develops 268 horsepower, is being demonstrated by its inventor, C. R. Klein, of Santa Monica, Calif.

Save Vanishing Totem Poles



At left is a totem pole in the form of a mountain lion. A government expert is at work restoring it near its original site at Kitwanga, British Columbia. Below, a remarkable example of a highly carved totem pole, unearthed near Jasper, Alberta

THREATENED with destruction by time and neglect, the last of North America's picturesque totem poles are being saved by government experts of the United States and Canada. Instead of being carted away to museums and parks in distant cities, they are being restored and preserved in their original settings in Indian villages of Alaska and the west coast of Canada. Carved in grotesque shapes depicting fantastic animals and birds, these emblems were originally erected by Indian tribes as symbols of their clans, serving the purpose of aboriginal coats-of-arms. Each pole was shaped from a single tree, and some towered as high as sixty feet. When the natives moved from their primitive homes to more modern dwellings, the poles were left behind. The Indians seldom troubled to fix a pole that fell down; its re-erection would have entailed as complicated a ceremonial ritual as its initial installation. When it became apparent that the few remaining examples of this ancient art would soon vanish, the governments of the two countries decided to try and save them.

Each remaining pole is now being taken down and examined for signs of weakness or decay, and then restored to original form.

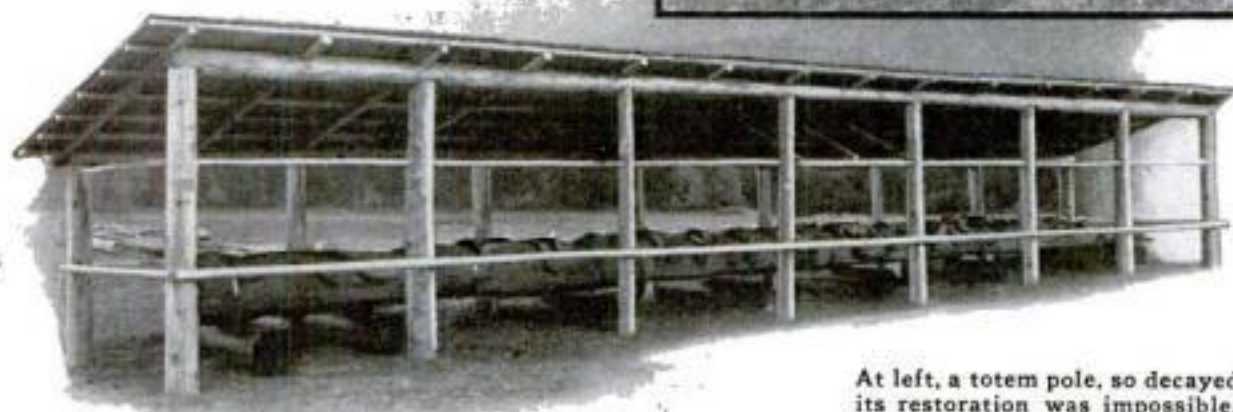
After the totem pole is thoroughly repaired, it is hoisted to its original position, as seen at right



Gitskan Indian left, is restoring the faded colors on an old totem pole

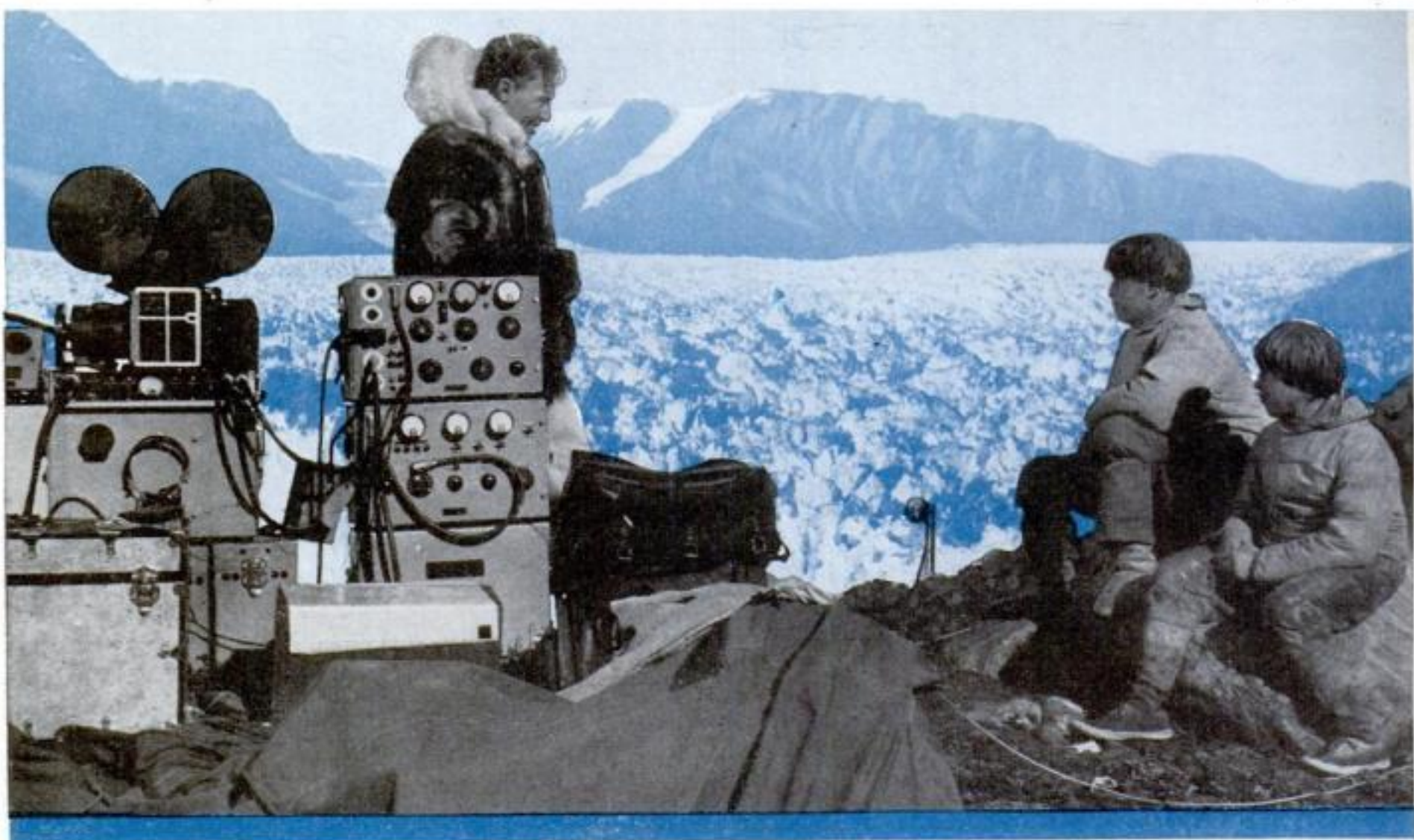


To preserve a pole, a core of hard wood is being fitted into it, as illustrated at left



At left, a totem pole, so decayed that its restoration was impossible, was protected by a shelter built above it





On the edge of the Rink Glacier in northern Greenland, where icebergs are born. Cameras to record sound and motion are in place ready for use. Note microphone near center of photo

CRACKUP OF Mighty Glacier

caught for first time by
SOUND CAMERA



Putting film in a camera during sub-zero weather is a hard job

PERCHED with our cameras and sound apparatus on a rocky eminence of a fiord in northern Greenland, we looked down upon the great Rink glacier, cracking and groaning on its way to the sea. Jagged white pinnacles of ice, sparkling with a million highlights in the sun, filled the gorge from wall to wall, a frozen river four miles wide. The sea came up the fiord to meet it, lapping at the base of the 400-foot precipice of ice that formed its visible lower edge; below the water, the glacier extended

down into the Arctic depths 1,800 feet.

Eventually, we knew, as the glacier pushed its way into deep water, its buoyancy would strain the advancing mass so forcefully that the whole face would crack off, be lifted bodily from its parent glacier, and shatter into hundreds of mammoth icebergs. This is one of the two principal ways in which the icebergs that menace ocean shipping lanes are born; the other, less violent, is by the disintegration of floating polar ice.

To obtain for the film "S.O.S. Iceberg," the first sound movies ever made of a glacier's crackup, we had traveled half-way around the world and topped off the journey with a perilous boat trip up the fiord among closely packed ice floes. Now, after a ten-day vigil at the scene, we knew the moment we awaited could not

Major Udet punctured the pontoons on his plane when landing in the midst of a vast field of floating ice in Arctic waters

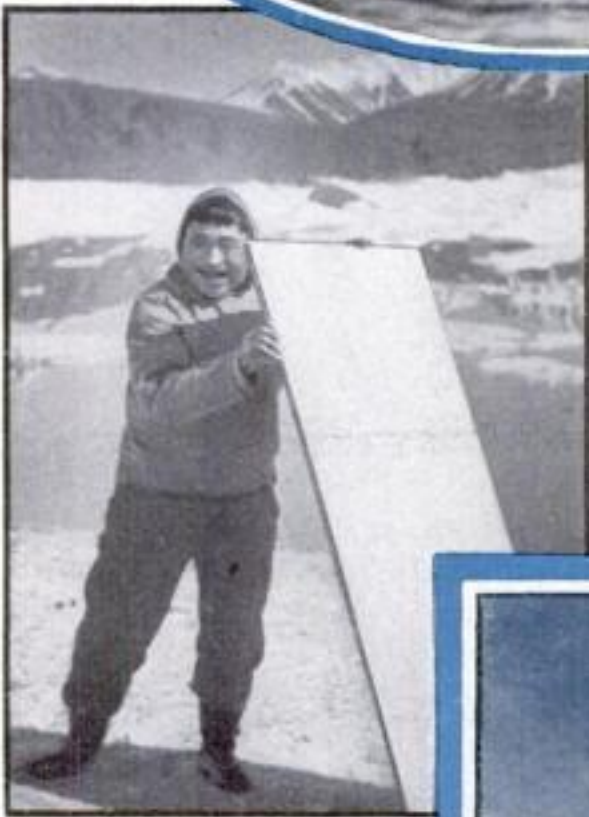


be far away; for the Rink glacier is the swiftest-moving, as well as the highest, surface ice in the world. Dr. Ernest Sorge, one of our scientific advisers, occupied himself by timing it. Constant straining, breaking and re-freezing had given the ice so rough a surface that it was impossible to set foot upon it to place a marker; but Dr. Sorge followed the movement of first one particular pinnacle, then another, with a theodolite from the bank. He found the sharp spires shifted constantly with respect to each other and to the shore, but on the average the glacier slid forward seventy-two feet daily.

We were eating breakfast on the morning of the eleventh day when an Eskimo in our party gave the alarm that the break was starting. Food forgotten, we rushed to our posts. As I reached the sound apparatus, joined by a frozen cable to a gauze-covered microphone 500 feet nearer the ice wall, the roar almost split my ears. I tuned down and down, yet my phones continued to bring me the terrific blasts of an artillery barrage. Standing up for a better view, I saw great chunks breaking from the wall of the ice cliff. Mist rose a thousand feet high. As the roar grew, the bottom of the wall moved majestically outward and upward.

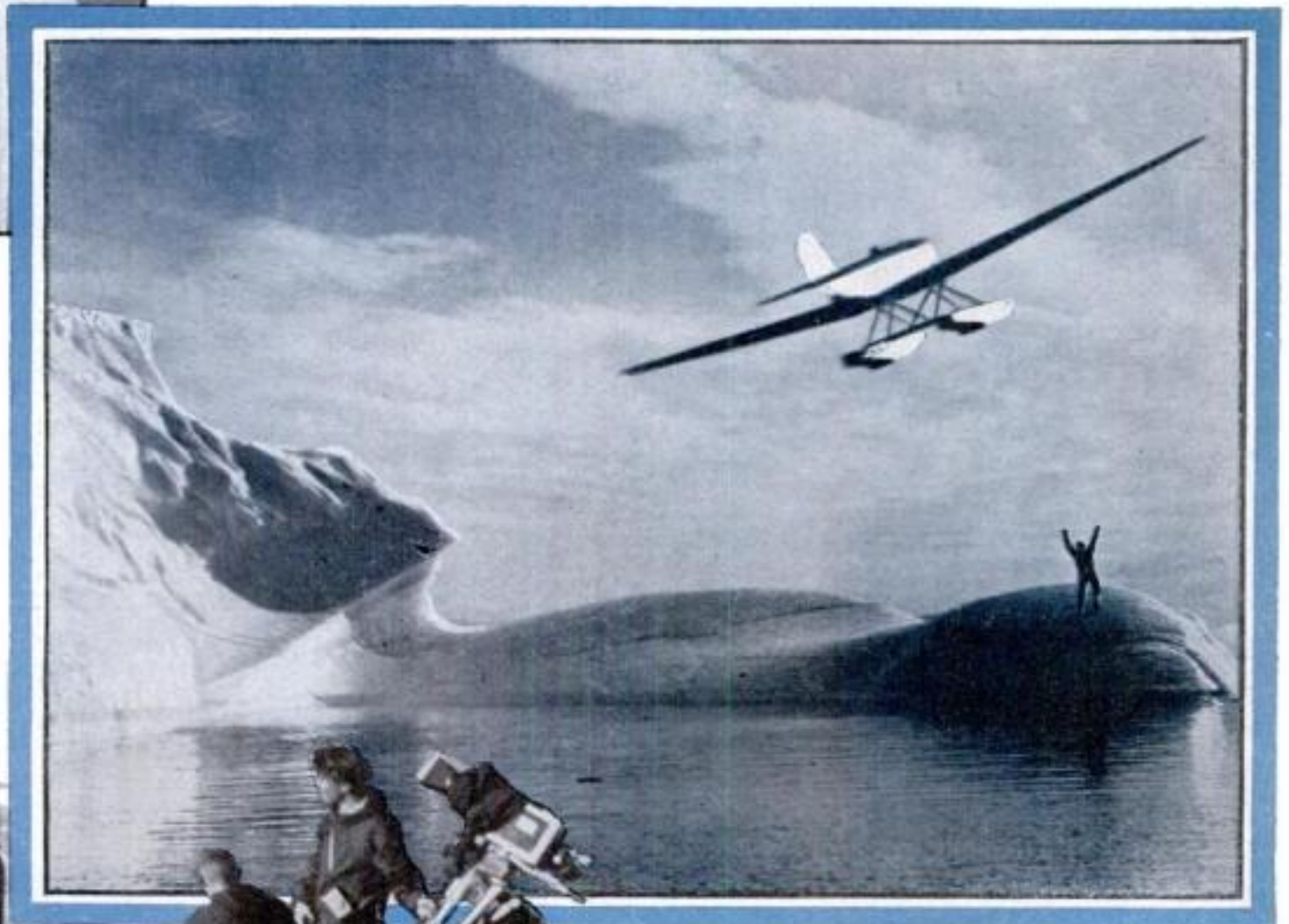
Then suddenly the entire wall gave way for a width of fully two miles and a thickness of six hundred feet. Breaking into scores of ice-

Movie Expert Tells of Thrilling Stunts in Arctic Greenland as Birth of Icebergs Is Recorded on Film



Greenland Eskimo supporting reflector, needed in spite of the field of glistening ice

By
**ZOLTAN J.
KEGL**



DANGERS FACED TO GET FAR NORTH PICTURES

Udet flew his plane close to a giant berg so the photographer could get the beautiful picture reproduced above. At left, forcing a boat through masses of ice to get the camera into position to make the sound and movie film of the mighty event



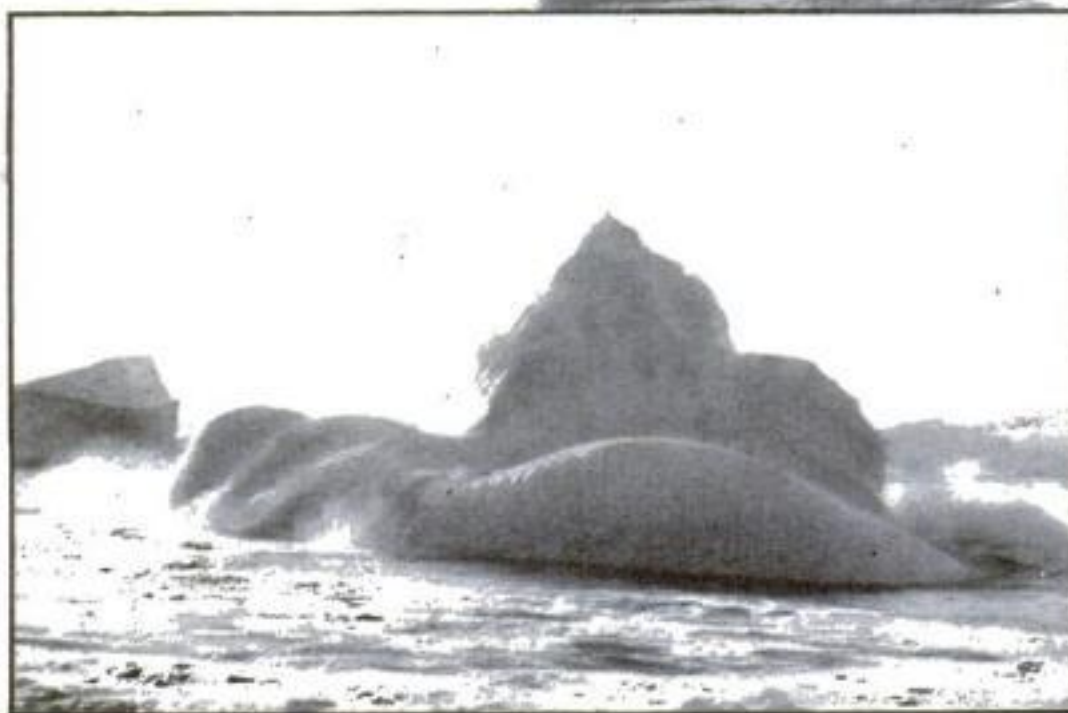


Blast of Dynamite Fails to Shatter This Big Berg

In an effort to tear an iceberg to pieces, big blasts of dynamite, above, were detonated. The face was blown off but the berg remained almost as big as ever. At left, the drill that was used in digging hole in ice for the dynamite



Close-ups of the ice were taken by a camera lashed to the bow of a kayak



This is one of the most remarkable pictures made in the Arctic region. It shows the immense iceberg, containing 10,000,000 tons, slowly turning over. Efforts to blast this berg failed but later it somersaulted of its own accord

bergs, each larger than New York City's Empire State Building, it plunged down and outward toward the sea. Ear-splitting reports came one after another, so rapidly that we could not distinguish them. The ground where we stood shook with the force of the icequake.

Though we were nearly half a mile from the glacier, fine mist quickly drenched us. Rocks loosened by the terrific crash raced down the steep cliff past us as we worked to record the cataclysm. When the last piece, as large as the national Capitol, had thundered down, I had 1,000 precious feet of sound film.

Our escape was cut off. The icy avalanche had crushed our boats, and had so completely choked the fiord with ice that no rescue craft could get through. We had rations enough for only three days. But waves sweeping down the fiord from the scene of the ice crash, ten feet high as they passed the base of our expedition at Nugaitaik, fifty miles away, had told Dr. Arnold Fanck, leader of our expedition, that the glacier had been "calving" and that we might need help.

On the second day after the crash we heard the welcome drone of a plane and Major Ernst Udet, crack German flyer with our expedition, flew overhead. I laid out panels requesting food, by pre-arranged

signals. Later in the day his tiny monoplane reappeared and he dropped provisions.

Two days later, with the aid of a pair of Alpinists who came to our assistance, we were able to reach the rescue boats by the land route, abandoning our camera equipment. Good luck enabled us to go back and salvage it the following week when an easterly wind broke up the ice jam in the fiord and sent the floes drifting.

Our work was not yet done. We put out in our small boats from Nugaitaik, with one camera strapped to a two-place kayak for ready maneuverability, to get close-ups of individual icebergs wallowing, turning over, and breaking up in the sea, and of polar bears playing among them. These we secured near the coast, together with pictures of Major Udet landing on the water among the floes.

in his kayak was near enough to save him.

Not far offshore we spotted another berg, a floating chunk possibly as large as a fifteen-story building, and weighing some 10,000,000 tons. Securing myself as best I could, I bored a row of six-foot holes with my auger and charged them with 100 pounds of dynamite. The blast shook the countryside, a small block of ice flew off—and the berg merely shivered and resumed its lethargic pose.

Then, three hours later, the berg came to life while we were staging another scene nearby, showing Major Udet being rescued from a disabled plane by Eskimos in their kayaks. Without warning, the enormous iceberg rolled completely over in the sea. If the native stagehands had been a little slower in their rescue of Udet, we might have had a fatal accident.

Girl Fights Octopus

FOR UNDERWATER MOVIE

Below are three views of girl swimming twenty feet beneath surface of pool. At right, about to come to grips with octopus

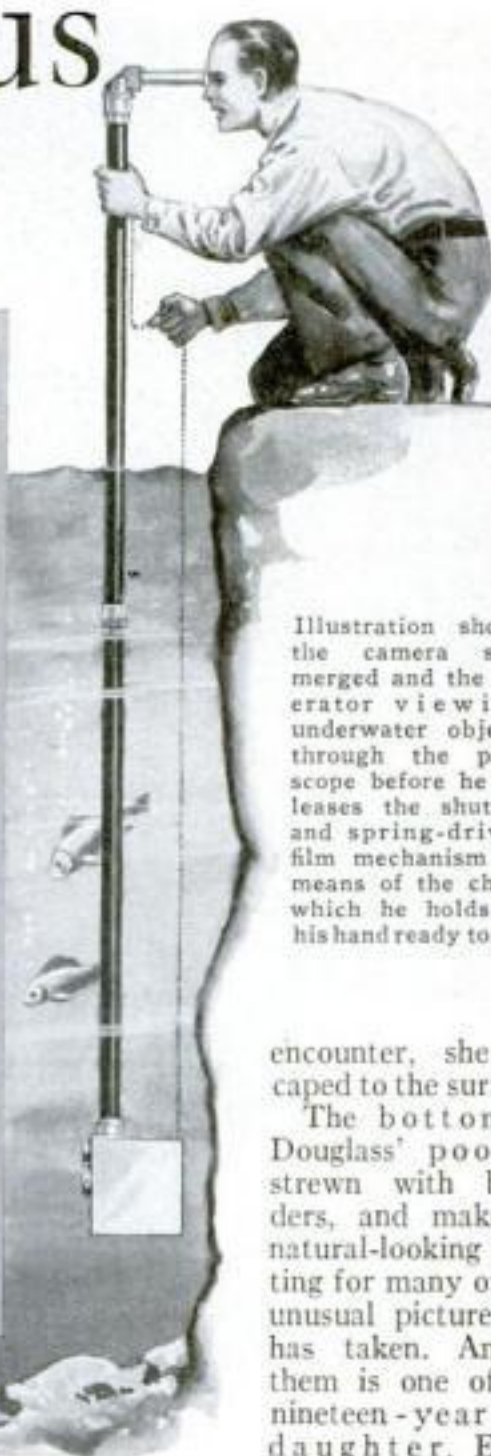


Illustration shows the camera submerged and the operator viewing underwater objects through the periscope before he releases the shutter, and spring-driven film mechanism by means of the chain which he holds in his hand ready to use

encounter, she escaped to the surface.

The bottom of Douglass' pool is strewn with boulders, and makes a natural-looking setting for many of the unusual pictures he has taken. Among them is one of his nineteen-year-old daughter, Ena, swimming beneath the surface with bits

of food tempting a seal to follow her. His point of vantage for the underwater scenes is a submerged window in the wall of the pool, reached from the outside by a small tunnel.

Devising improved cameras for photographing submarine scenery is Douglass' hobby. One of his inventions is a water-tight camera fitted with a long periscope, so the photographer can lower the instrument from the surface and see through the tube of the periscope what he is filming. Extra sections may be added to lengthen the periscope, which also serves as a handle to maneuver the camera.

When the observer sees an exotic fish or a rare coral formation appear in the eyepiece, he tugs on a small chain that actuates the shutter mechanism and the scene is recorded. Another Douglass invention is a cone-shaped water glass six feet long, used to inspect the depths before lowering the camera.

These devices proved their worth in their first test last spring when Douglass accompanied the Johnson-Smithsonian Deep-Sea Expedition, jointly sponsored by the Smithsonian Institution and Eldridge R. Johnson, of Philadelphia, to record the wonders of tropical marine life off Puerto Rico. Now Douglass seeks to perfect a camera equipped with lights that will permit underwater photography at unheard-of depths.



This is the camera with which underwater pictures, like those shown on this page, are taken. The tube on top of the camera is the part of the periscope through which operator looks in taking underwater views

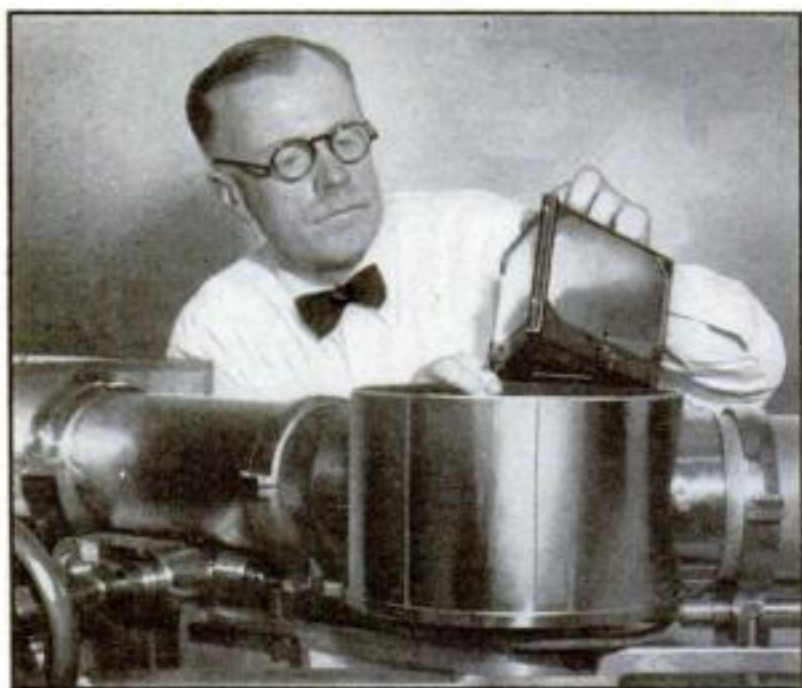
ADVANCING with easy, graceful strokes, a young girl swims under water across the field of the movie camera. Ahead of her lurks that strange monster of the deep—a huge octopus whose frightful tentacles move slowly to and fro. Apparently unaware of the danger, the swimmer comes within reach of one of the slimy arms. . .

With this dramatic scene, Leon F. Douglass, wealthy sportsman and inventor, was trying out a new camera of his own design. His stage setting was an especially designed swimming pool on his estate of fifty-five acres at Menlo Park, Calif. The star of his exciting movie was his seventeen-year-old daughter, Florence. An expert swimmer, she readily volunteered to do sham battle with a twelve-foot octopus brought in a tank from Samonica Bay, Haiti. The huge creature seemed exhausted by its long trip and was supposed to have little fight left in it.

With the camera shutter clicking away, everything started as planned. As the tentacles of the octopus encircled the dar-

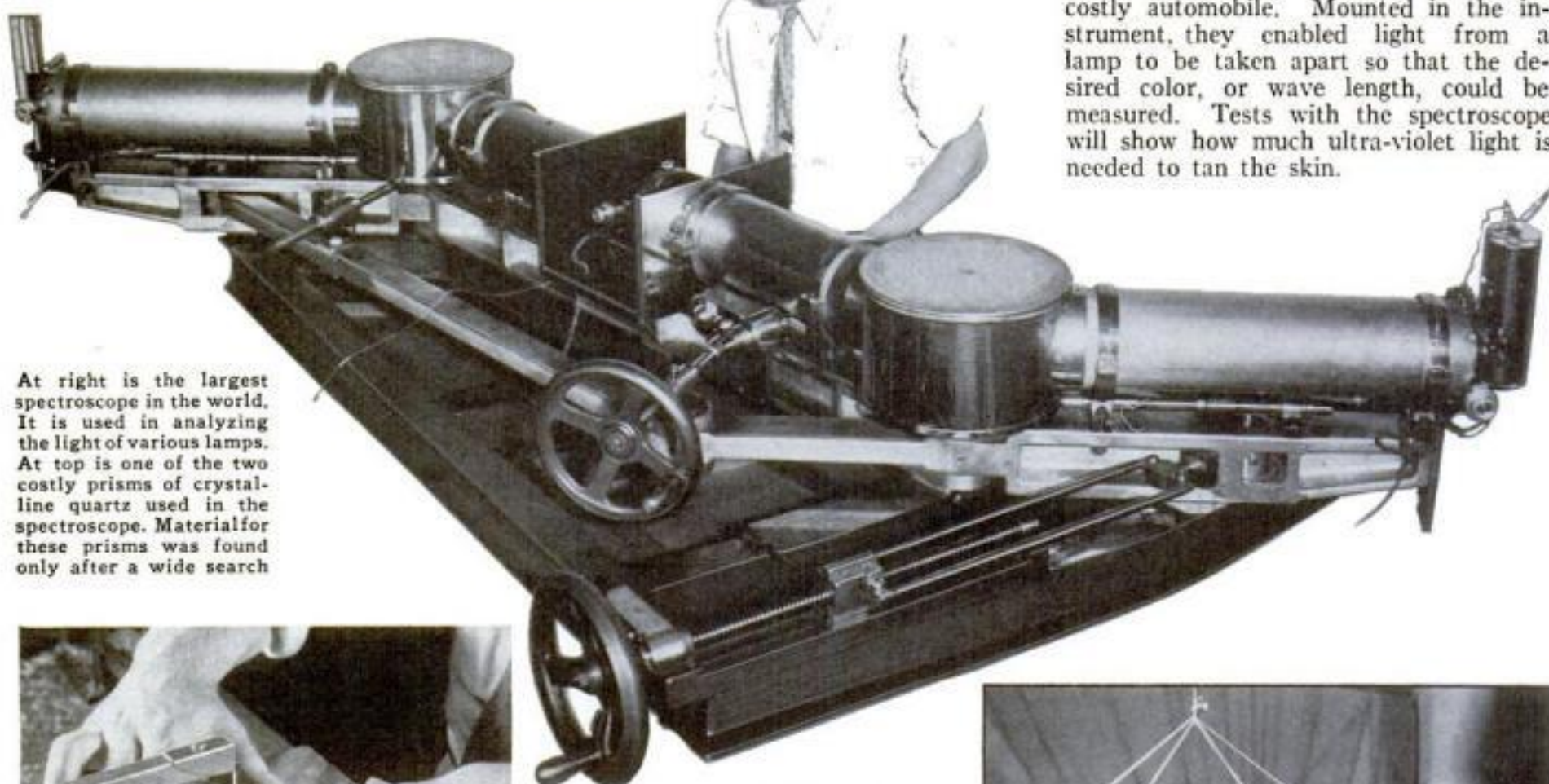
ing girl, however, it became apparent that something was wrong. The hideous sea monster was showing unexpected life. Sinuous arms, studded with suction cups, wound themselves around the arms, legs, and body of the struggling swimmer. Bubbles floated to the surface, telling of the loss of air from her lungs as she fought to free herself. Men who had been posted at the pool's edge, to give aid if needed, dived to her rescue and fought to throw off the clinging coils that held the girl. Released at last, black-and-blue from her

WORLD RANSACKED FOR SPECTROSCOPE PRISMS



New facts about health lamps are being discovered in a Cleveland, Ohio, laboratory by scientists armed with the largest spectro-scope in the world. Behind the construction of this giant instrument lies a story that shows the lengths to which experi-menters must go in obtain- ing the tools with which to work. When General Electric engineers set out

to design an instrument technically known as a "double monochromator," with which the intensity of any particular wave length of light could be measured with great precision, their plans called for prisms of crystalline quartz with faces four times as large as those commonly used. Quartz was needed because it transmits ultra-violet rays with undiminished strength. When an order was placed with a German optical firm for two triangular prisms, four inches high and six inches along the edges of the base, it was discovered that no single piece of crystalline quartz large enough to make such a prism was known to exist! A world-wide search followed. Finally, in Brazil, the needed crystals were found. Two gems of the optician's art were produced—a pair of prisms equalling in value a fair-sized house or a costly automobile. Mounted in the in-strument, they enabled light from a lamp to be taken apart so that the de- sired color, or wave length, could be measured. Tests with the spectroscope will show how much ultra-violet light is needed to tan the skin.



At right is the largest spectroscope in the world. It is used in analyzing the light of various lamps. At top is one of the two costly prisms of crystal-line quartz used in the spectroscope. Material for these prisms was found only after a wide search



JIG-SAW KIT FOR TOY FURNITURE

Toy furniture for children is easy to make with the aid of a jig-saw construction kit recently placed on the mar- ket. It contains sheets of wood that are stamped with patterns to be cut out with a hand or power saw, as shown above, the pieces then being glued together. Kits for toy soldiers are also supplied.



RADIO SINGER IN CELLOPHANE BELL

To put the voice of a coloratura soprano on the air with fidelity, broadcasting engineers have devised a cellophane "bell" within which the singer stands. Covering her down to the waist-line, the transparent envelop is said to do for the human voice what a mute does for a cornet or violin, and the singer can render her highest notes without fear of causing unpleasant vibrations in the microphone. The latter is placed outside the bell in the po- sition shown in the photograph. By this novel expedient, a prob- lem that has baffled broadcasters for years is believed to have been solved, and the results are ex- pected to become apparent in the improved quality of the voices that radio listeners will hear in their home sets. It is ex- pected that experiments will show other uses for the cellophane bell.

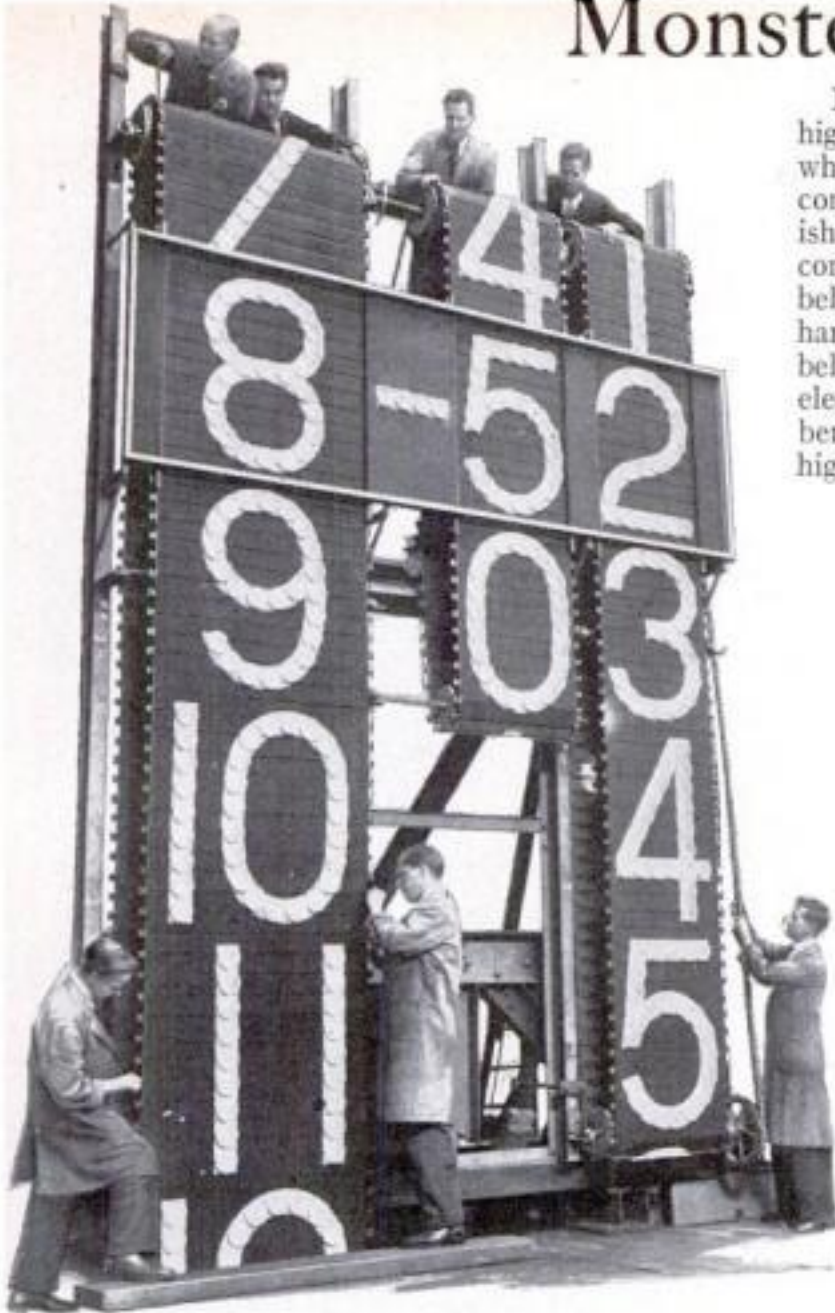


Voice of radio soprano, passing through cellophane envelop to microphone, loses unpleasant vibrations

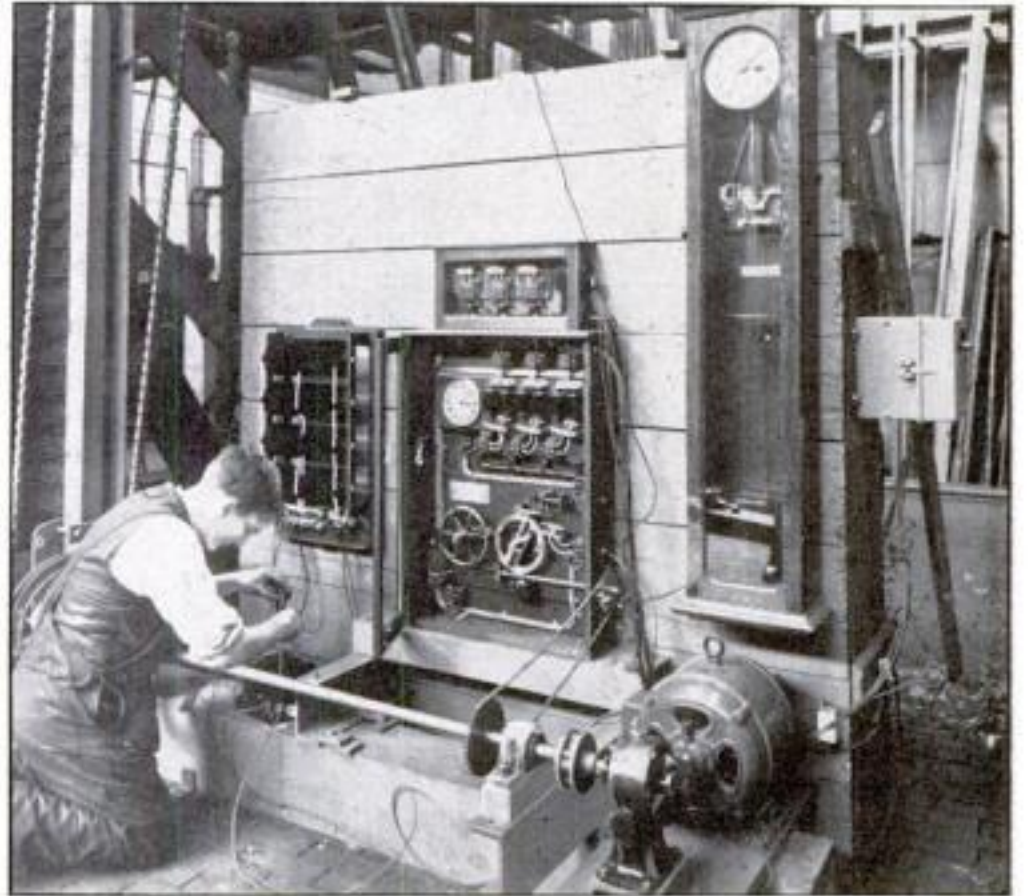
Monster Clock Has No Hands

Moving numerals, three feet high, will tell Londoners the time when a monster clock now under construction in one of this British city's railroad stations is completed. The big timepiece is believed the largest without hands ever built. Three endless belts of steel slats, driven by an electric motor, carry the numbers past a rectangular window high on the station wall where

they are made visible. Each numeral is outlined by silvered disks of reflecting material, and floodlights play upon the figures to make them show up clearly at a distance. The movement of the belts is governed automatically from a control panel with an extremely accurate master clock, which in turn is constantly regulated from the observatory at Greenwich. The steel roller on which the hour numerals are shown is thirty-seven feet long and the blinds weigh about 15,000 pounds.



Installing numerals in the world's biggest handless clock. At right, control panel and electric motor that runs the clock



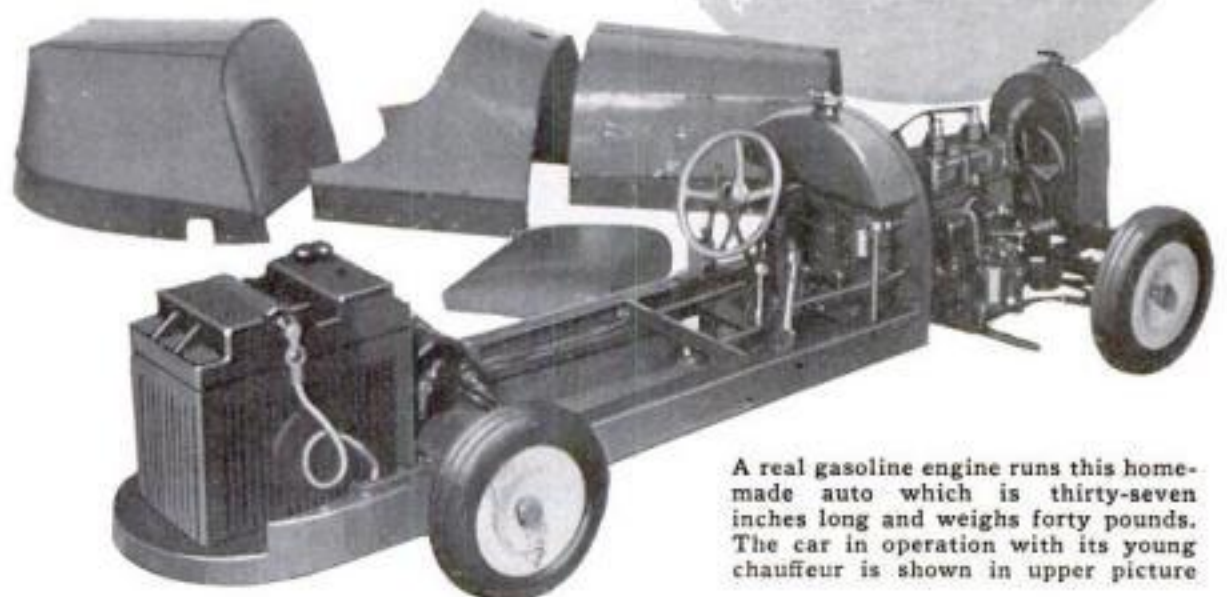
FLASH-LIGHT BATTERIES WORK FOREST PHONE

OPERATING on flash-light batteries, a new type of field telephone has been developed especially for use by forest-fire fighters and has been tried out successfully in tests near Vancouver, Wash. The aluminum case weighs less than four pounds and contains three dry cells, with a condenser and other necessary electrical accessories. As soon as the two wires shown in the photograph above are hooked up to the line, the phone is ready for action. Formerly it was necessary to carry heavy batteries and cumbersome equipment over difficult trails to set up communication.

FORTY-POUND AUTO CARRIES SMALL PASSENGER

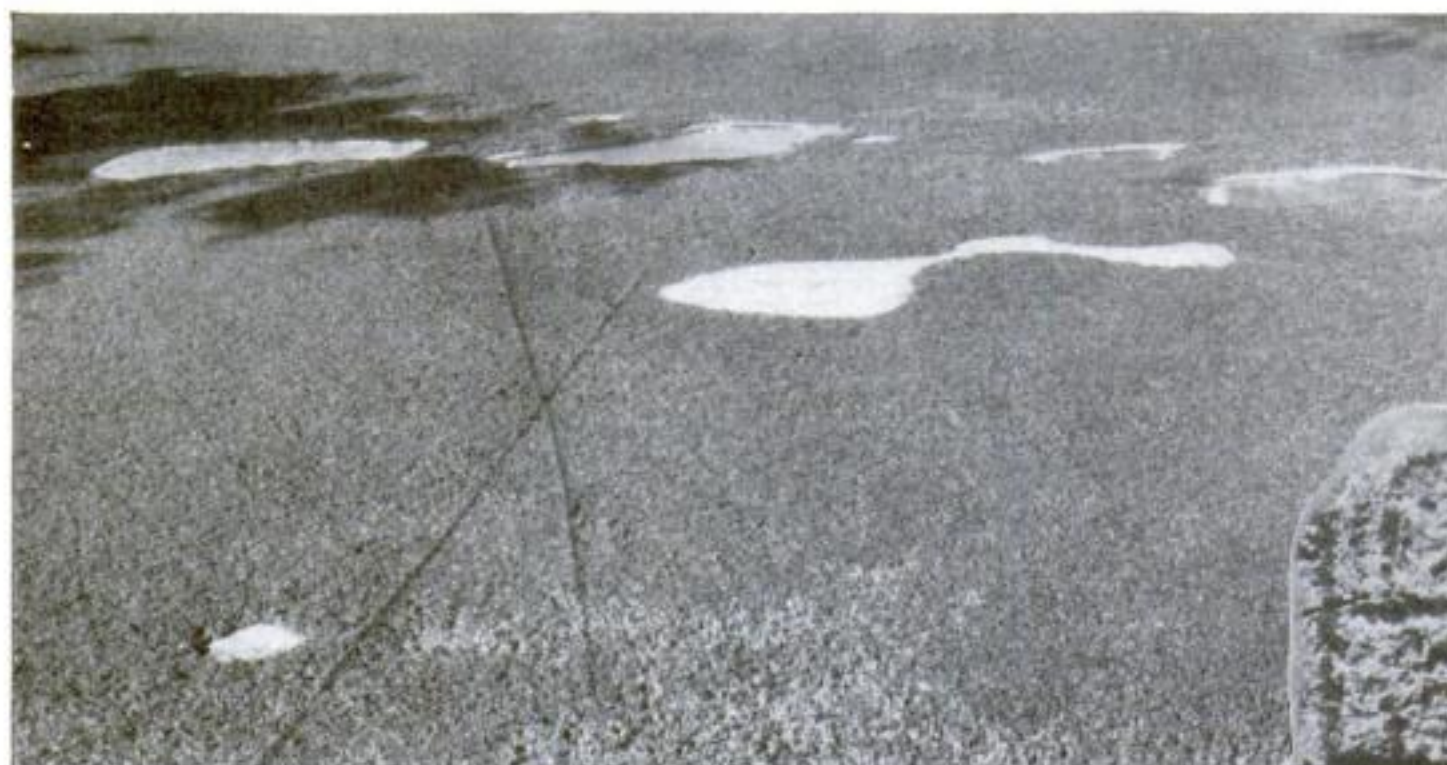
So TINY it could easily be mistaken for a toy, a thirty-seven-inch gasoline automobile that really runs is the spare-time handiwork of Paul S. Otto, sales manager of an Iowa City, Iowa, advertising firm. His three-year-old son is the chauffeur. Dimensions of the midget car seem to bear out Otto's belief that it is the smallest passenger-carrying machine ever built. It has a wheelbase of only twenty-five inches and weighs forty pounds. Despite its small size, it easily carries its youthful driver at twenty miles an hour. The car required 2,000 hours to build. Its two-cylinder motor, according to Otto, looks and works exactly like big ones, and is complete with three-jet carburetor, miniature spark

plugs, distributor, muffler, water pump, radiator, fan, clutch, and gearshift.



A real gasoline engine runs this home-made auto which is thirty-seven inches long and weighs forty pounds. The car in operation with its young chauffeur is shown in upper picture

America's Oldest Road Roller Found



Two ancient Mayan roads can be seen intersecting in the air map at left. The centuries have nearly obliterated them, but they were once masterpieces of road work. Below, one of the road markers, either a date stone or mile post

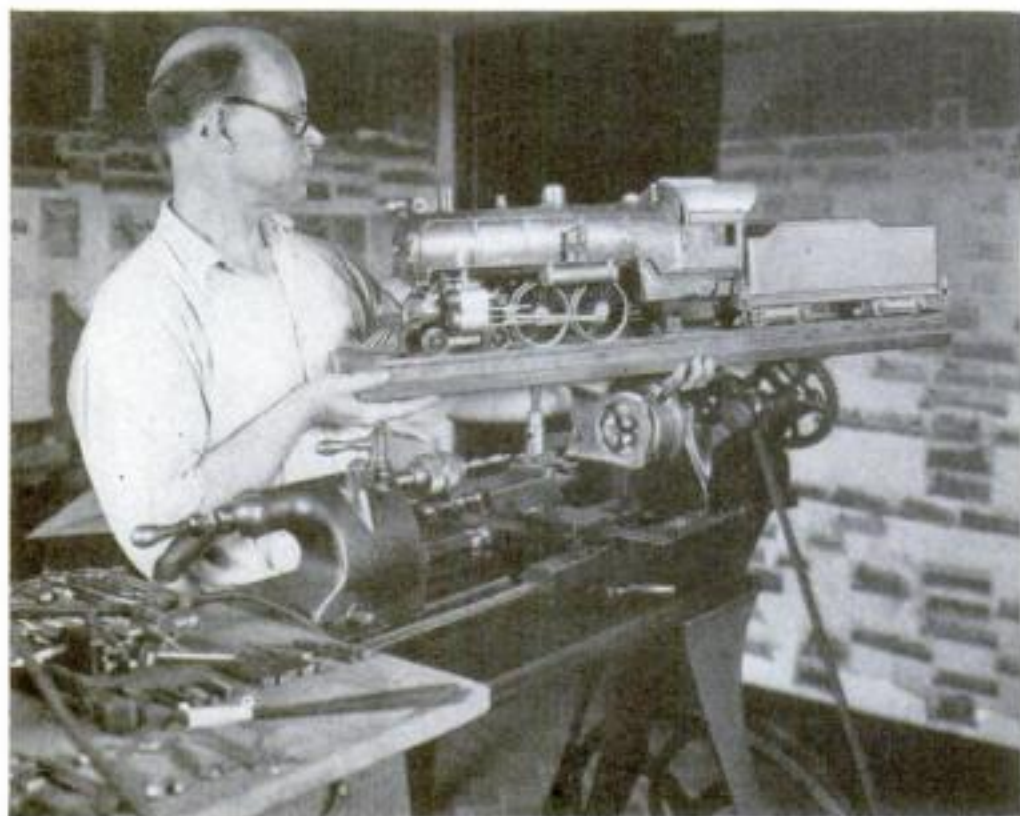
WHAT is believed the first road roller ever used in America has just been discovered by a Carnegie Institution exploring party in a jungle of northeastern Yucatan, Mexico. Broken in two pieces when found, it must originally have been a segment of solid stone of cylindrical shape, thirteen feet long, about two feet in diameter, and weighing about five tons. Experts say it was probably employed by the ancient Maya inhabitants, 1,100 years or more ago, to smooth the surface of the amazing highways that they built to connect their cities. Traces of these highways, now overgrown by jungle vegetation, are still visible; and it was during an exploration of one of them, that the road roller was discovered. Masterpieces of engineering, the roads apparently were built solely for pedestrians, since the Mayas had no beasts of burden nor wheeled vehicles. The ancient builders first dug down to hardpan and erected re-

taining walls of stone and mortar on either side to the desired height of the road. The space between the walls was then filled, first with large and then with successively smaller boulders, ending with a top surfacing of mortar cement. Each layer as it was applied was probably smoothed with the heavy roller.



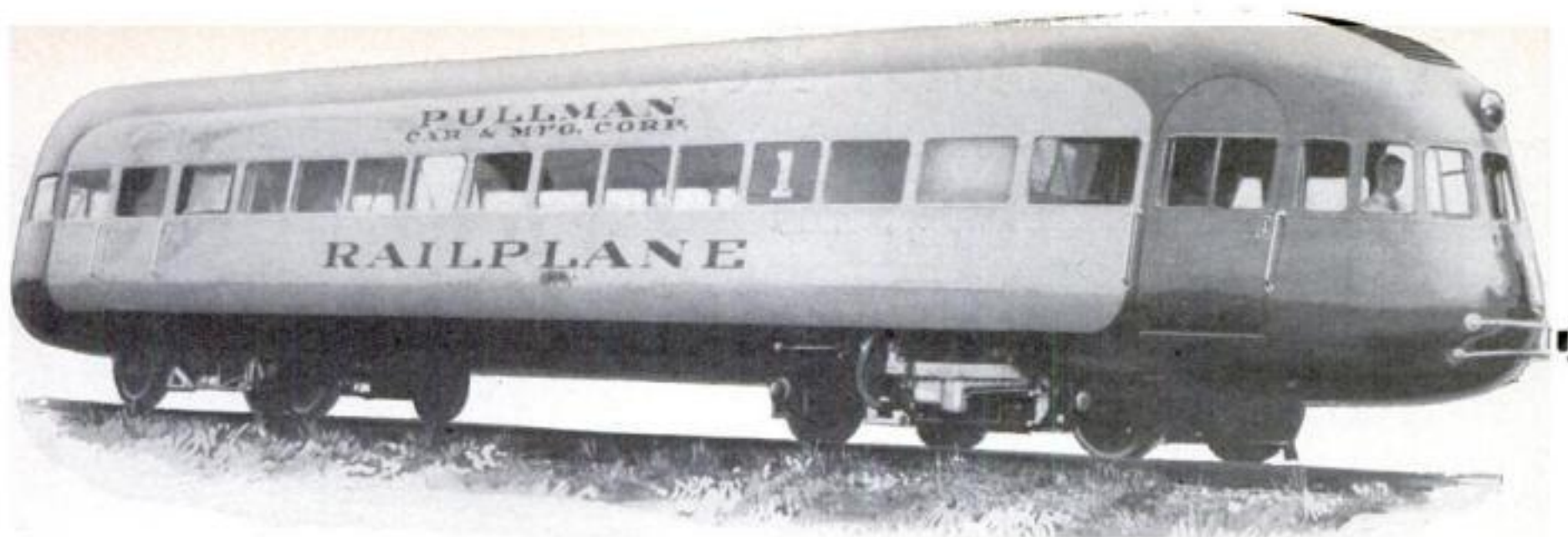
Oldest American road roller, used by Mayans, was thirteen feet long and weighed about five tons

Federal Official Builds and Sells Model Locomotives



Albert F. Clow, Washington, D. C., building a model locomotive in his workshop. He is a Federal official but he gets profit and fun from his hobby

PROFIT as well as pleasure is derived from his hobby by Albert F. Clow, special investigator and attorney with the Interstate Commerce Commission at Washington, D. C. His spare-time hours are occupied in building miniature locomotives that run under their own power. Orders for his engines come from retired engineers of leading transportation systems, who desire faithful copies of their favorite engines as mementos of their days behind the throttle. So far Clow has constructed fourteen of these models, selling them at prices ranging from \$150 to \$300 apiece. The engines burn either coke or soft-coal siftings on their tiny grates, and can develop as much as eighty pounds' pressure of steam. They travel at speeds up to fifteen miles an hour on suitable track. The largest locomotive Clow has built will easily haul a load of 300 pounds. Always interested in model locomotives, Clow spends eight to ten hours a week in his basement workshop, which is inexpensively but adequately equipped with a foot-operated lathe and homemade milling attachment, a stout work bench, a bench drill, a vise, and a complete outfit of hand tools for both wood and metal work. Hundreds of pictures of locomotives cover all parts of the walls often aiding in solving problems of design. It takes Clow from nine to ten months to design and build a locomotive model, like the one complete in every detail that is shown at the left, which may contain as many as 3,000 parts.



AIRPLANELIKE RAIL CAR HITS NINETY-MILE SPEED

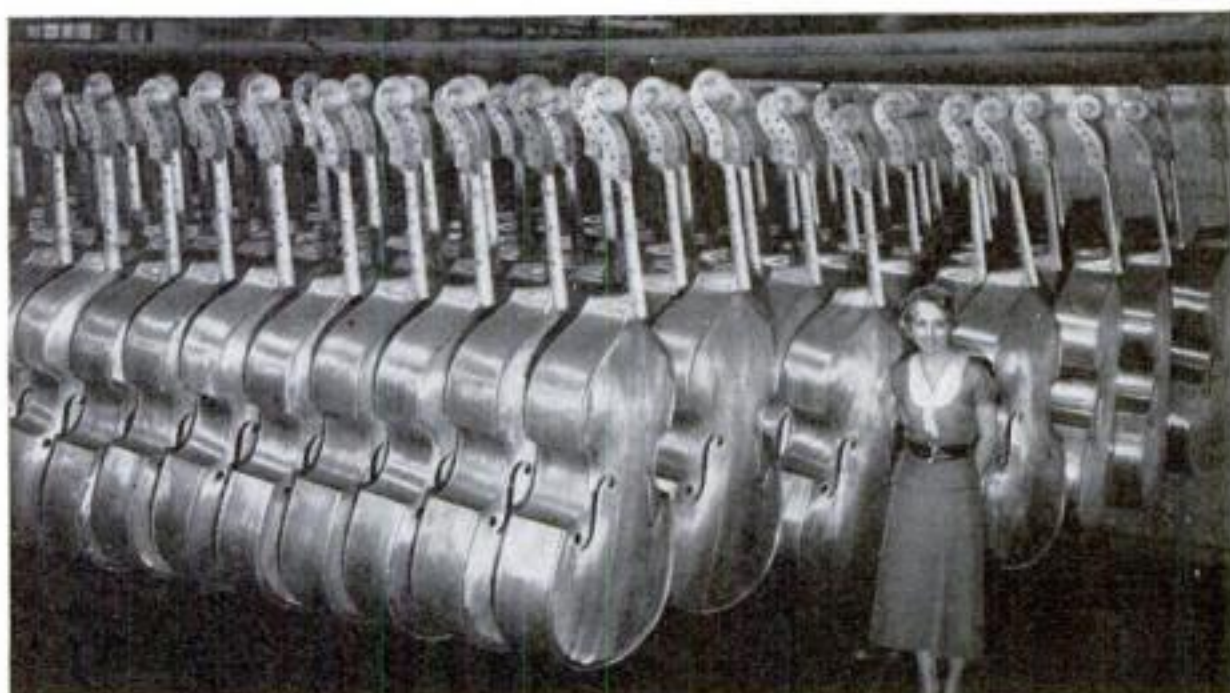
AIRCRAFT architecture is adapted for railway use in a new vehicle known as "rail plane" and designed for high-speed interurban service. The new car was tested successfully at Chicago the other

day. Seating fifty persons and driven by two internal-combustion motors on the front truck, the car can attain ninety miles an hour. Wind resistance is cut in half by the streamlined outer shell of

duralumin that encircles the new car, reducing the waste of power from this cause by fifty percent. As a result the sensation and nearly the speed of air travel is attained.

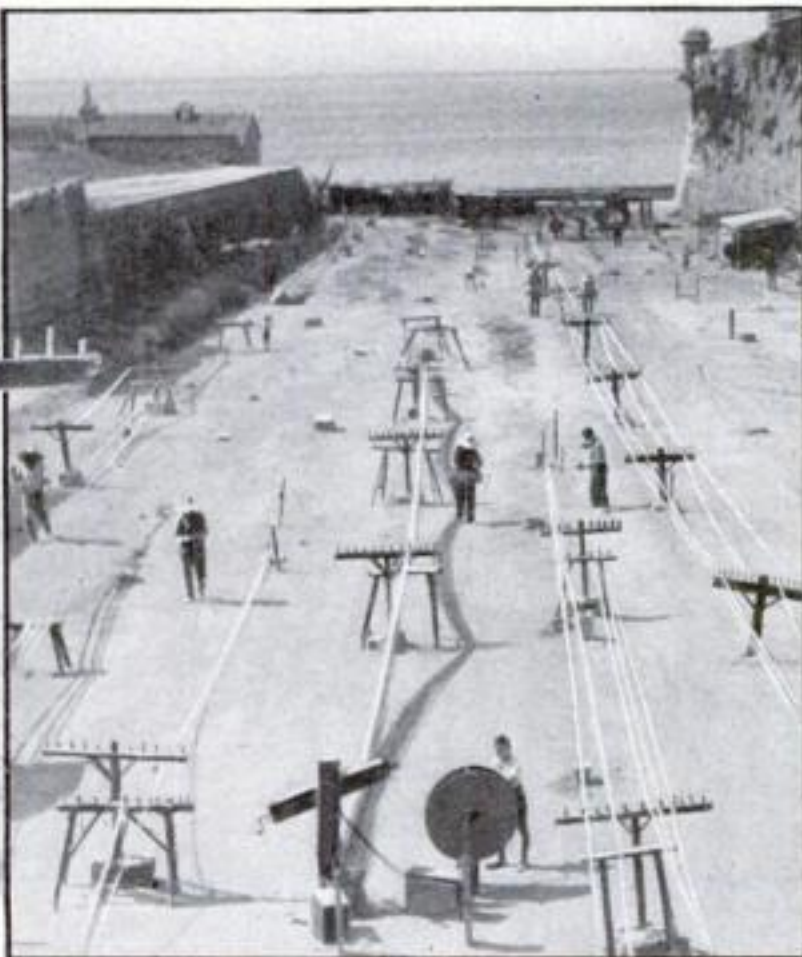
ALUMINUM BASS VIOLS USED IN ORCHESTRAS

DECLARED to possess a tonal quality that compares favorably with wood instruments, aluminum bass viols are gaining in popularity among musicians of dance and symphony orchestras because they are impervious to moisture. The unusual picture reproduced at right shows more than a hundred of the instruments at the Buffalo, N. Y., factory where they are made. In the process, light, strong sections of aluminum alloy are rigidly welded together without the use of screws or rivets. In finishing them they are given a natural aluminum, gold bronze, or imitation wood appearance. The designer says many other stringed instruments can also be given a satisfactory tone.



ROPE MAKERS OF SPAIN TWIST STRANDS BY HAND

Right, rope factory at Palma, Spain, where rope is made by hand. Below is shown rope maker weaving a strand of rope by primitive methods



IN SURROUNDINGS that suggest a buried city, its telegraph poles half-covered by sand, native rope makers of Palma, Spain, ply their ancient craft. Actually the "telegraph poles" are frames that support the hemp yarn as it is spun. To do this, one man fastens a bundle of hemp fiber around his waist, attaches one end to a hand wheel, and slowly walks away, paying out the yarn with his hands. Meanwhile an assistant turns the wheel to twist the yarn into a compact strand. When several such strands have been spun, these in turn are twisted together to form a rope.

DEADLY ANTISEPTIC NOT INJURIOUS TO HUMANS

A BIG BERTHA in the war on microbes has just been developed by cooperating scientists of Western Reserve University, in Ohio, and the University of Iowa in Iowa. It is a new antiseptic said to be 1,000 times more powerful than carbolic acid, yet harmless to man even if taken internally. The new product, soon to be placed on the market, is the result of seven years of research.

• *THREE AMERICAN* *Chinchilla Farms* PRODUCE MOST COSTLY FURS



Little larger than a man's hand, the pelt of this chinchilla, a small rat-like animal, is worth from \$200 to \$300

IF YOU want the world's finest fur coat, with wool long enough to thread a needle and fine as a spider's web, you can get it, not from animals roaming at large in faraway places, but from captive rodents.

On three farms in Idaho, Utah, and California these tiny chinchillas grow. Naturalists call them the "missing link" between the rabbit, the squirrel, and the rat.

From the South American Andes, a former mining engineer, alone of the scores who have sought with fortunes and considerable skill to remove these strange little creatures from their native haunts in Peru and Chile to European and American pens, has transplanted a dozen. Today his herd numbers 160, only twenty more than would be required to make one large coat like the one illustrated at the extreme right.

Yet these are the only known chinchillas in the world that are reproducing in captivity. In warm California weather and the colder winters of the northwest, they continue to thrive, six years after M. F. Chapman brought them from the Andes. In that time, they have increased more than thirteen fold despite losses from theft and disease.

Today the three herds at Idaho Falls, Idaho, Logan, Utah, and Inglewood, Calif., are worth a king's ransom. Single pairs for breeding have sold as high as \$5,000. One coat made up of 140 pelts has brought \$45,000. Single skins in New York and Los Angeles sell for \$200 to \$300. Smugglers occasionally offer pelts in the world's fur capitals, since neither live animal nor pelt may be legally re-



Here is the pelt of a chinchilla that was produced on one of the only three chinchilla farms in the world. It is stretched on a flat board to cure the fur

moved from South America, yet only one man, a New York furrier, is known to have a sufficient number to manufacture a full-length chinchilla coat.

Chinchilla fur is rare, beautiful. It once was worn only by monarchs and their queens, but the passing of monarchies and their fabulously wealthy courts has made the fur available to others. Not more than a dozen chinchilla coats exist in any American city; possibly not over a hundred in the world.

One naturally thinks of Russian sable when discussing rare furs. The great value of that fur comes not so much from its beauty as from the difficulty of trapping and matching the sables. Often two or three years is required to find a sufficient number of sable pelts to make one coat. Yet sables cannot be reared in captivity while chinchillas reproduce as well in American pens as in the Andes 16,000 feet above sea level.

They live their new lives in spacious

A full-length coat, like the one seen below, can be made of chinchilla fur at a cost of \$45,000. To make such a garment, about 140 pelts are necessary



Photo, Courtesy Willard P. George Ltd.

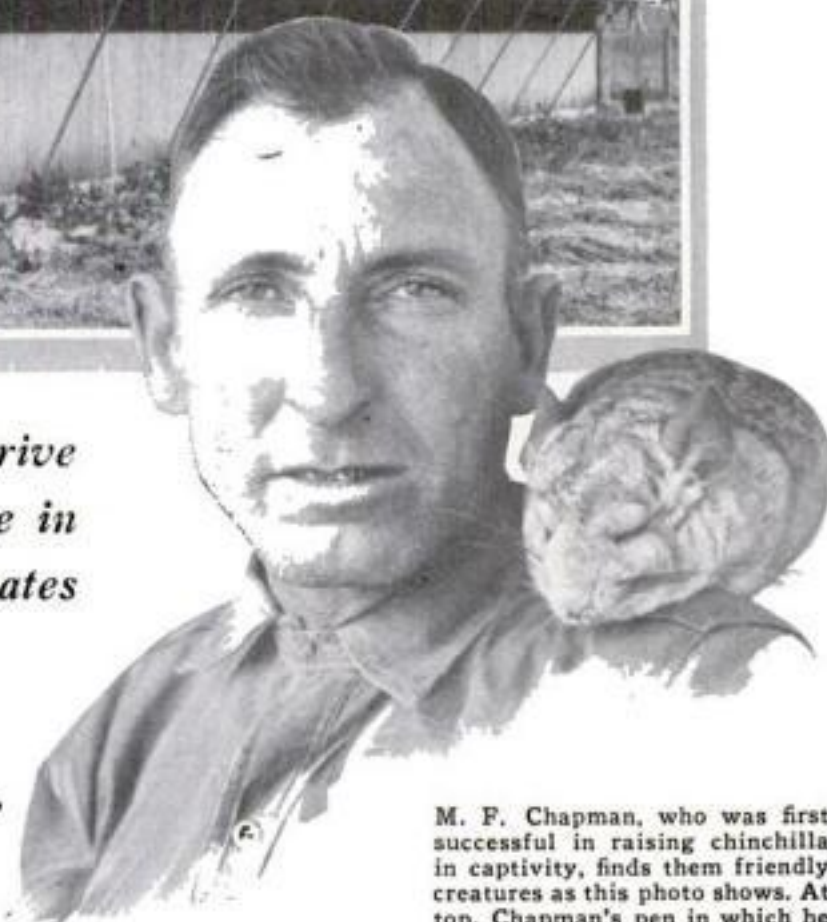
stalls measuring six by sixteen feet; one male and six females to each stall. From two litters a year in the wild, they have increased in many instances to three in captivity, the average of two young in each litter remaining the same.

"There are fewer chinchilla sales than sables," I was told by H. W. Blaine, a veteran fur expert, "but we account for that largely by its scarcity. There probably are not more than three chinchilla coats in America made up ready for sale. Whenever a furrier receives an inquiry for a chinchilla coat, he scours the coun-

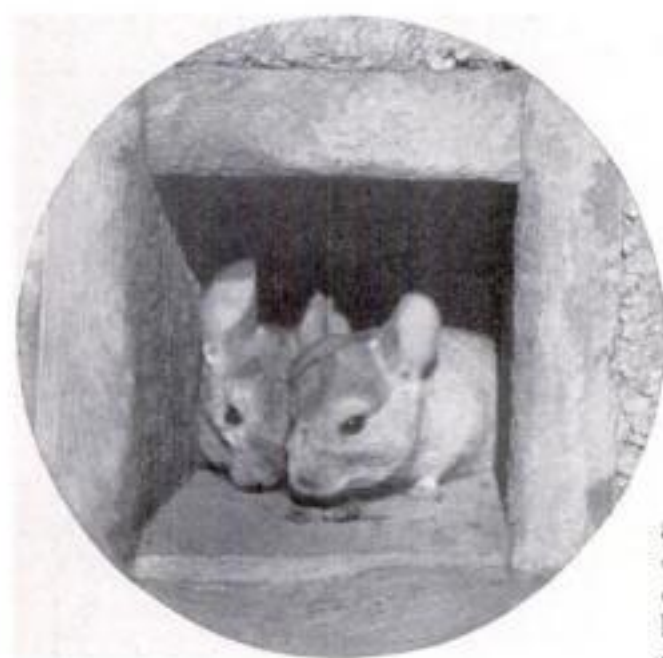


Wild Creatures from South American Andes Thrive in Captivity and Make Their Owner a Fortune in the Mountainous Sections of Our Western States

By
**ANDREW R.
BOONE**



M. F. Chapman, who was first successful in raising chinchilla in captivity, finds them friendly creatures as this photo shows. At top, Chapman's pen in which he keeps 160 of the little animals



In recesses made in their pens, the chinchilla live as they do in caverns when wild

try for pelts, buying them in lots of from three to a dozen. When he pieces them together they achieve a value of from \$15,000 to \$45,000, depending upon the number and quality of pelts."

Ermine, one of the most beautiful furs, white and blue fox, caracul are all found in women's wardrobes, yet chinchilla remains the most desired and least attainable fur in the world. Dyed rabbit at one-fortieth of the cost often is offered as a substitute, but an expert can tell a rabbit coat from a chinchilla at a distance of 100 feet.

Chinchillas are rabbit-like in appearance, though much smaller than the average rabbit. Little larger than a man's hand, they live among the Andean rocks. In captivity they spend much of their time in cavelike recesses of their pens. In the open, their protective coloring enables them to blend among the rocks and they can hardly be seen when on the run.

They emerge at dawn and at dusk to feed, eating the same vegetables and grains a domesticated chicken consumes,

though hardly as much. Chapman says his feed bill averages not more than \$1.80 a year per animal. They are subject in captivity to no more diseases than are American rabbits, and, when one dies, an autopsy usually reveals little balls of hair in the stomach. The chinchillas lick themselves and the long hairs pass with food into the stomach, where they remain undigested.

There are two commonly known species, although Chapman has had as many as five species growing together. Gradually four disappeared until he now has only the *Chinchilla lanigera*, found chiefly in the mountains of central and northern Chile. The skin is finer than that of other species and its color is a smoky gray with black markings, with the under parts a dead gray with a yellowish tinge.

As I held a fine male, stroking its long hairs, I realized why these rodents have been hunted since the remotest ages. Once the Incas wove warm cloth from their hairs, even domesticated them and ate the flesh after shearing the fleece. Though they have been known in South America for centuries, not until the turn of the century did any reach western markets. Immediately furriers became intensely interested and following the importation of a few skins to Paris, world-wide efforts began to bring chinchilla coats to wealthy men and women.

Yet Chapman is the only white man who has succeeded in raising them—and he has his difficulties. Someone recognized

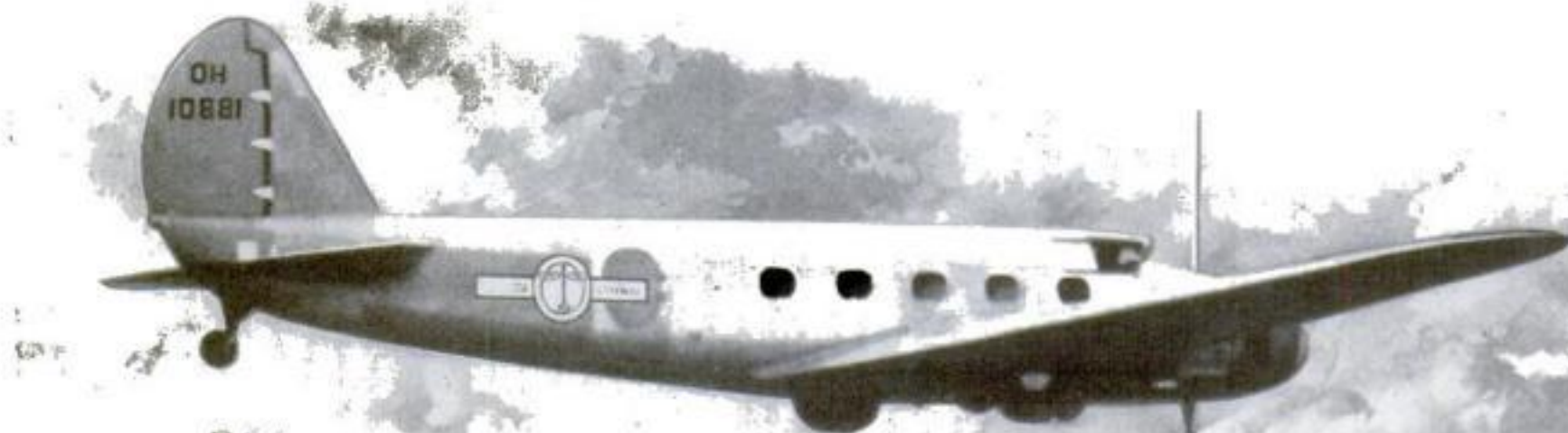
the tremendous value of the Chapman herd and in the dead of night stole into his mountain ranch at Tehachapi, Calif., (recently abandoned) and made away with thirty-five sturdy chinchillas. Sixteen were carrying young. The potential loss, therefore, amounted to fully seventy of the animals. Chapman, in swearing out warrants for the unknown culprits' arrest, placed a value of \$54,000 on the stolen animals.

Late last fall eighteen were traced to a ship bound for Germany. So closely did United States operatives press the hunt that they learned five died en route. Later one American confessed his part in the theft and today is paying the penalty in San Quentin prison. Two of those smuggled to Germany are alive today, all the others having perished. The other seventeen have not been traced.

Chapman's chinchilla exploit is packed with drama. Formerly a mining engineer, he went to South America nine years ago for a mining syndicate. He made his headquarters high in the Andes of Chile and Peru and while living among the native Indians and Chileans became interested in the chinchillas. He had heard great tales of their former high position in the international fur trade. One man had exported 100,000 skins from Chile in 1884. In 1901 fully 1,000,000 skins were exported from that country.

San Pedro de Altacama was the most important local South American market then. From *(Continued on page 103)*

DICK BOWMAN, Pioneer *Flies Down* Radio Beam



HEAVY, billowing fog was rolling up over the Tehachapi. In the distance, under the left wing of the big transport monoplane, I could still see the lights of Bakersfield marking a haven in the darkness. In the cabin, a dozen passengers sat at rest, reading, napping, gazing out into the night.

I pressed the button closing the transmitting circuit.

"Bowman to Burbank," I called, holding the mouthpiece close to my lips.

The line always remains open. We transport pilots, from Atlantic to Pacific, can speak at any time to ground operators at the scores of stations where experts stand constant watch, ready to give us information about the weather or instructions.

Without waiting for a reply I continued with the important request:

"Will you give me permission to go over the top?"

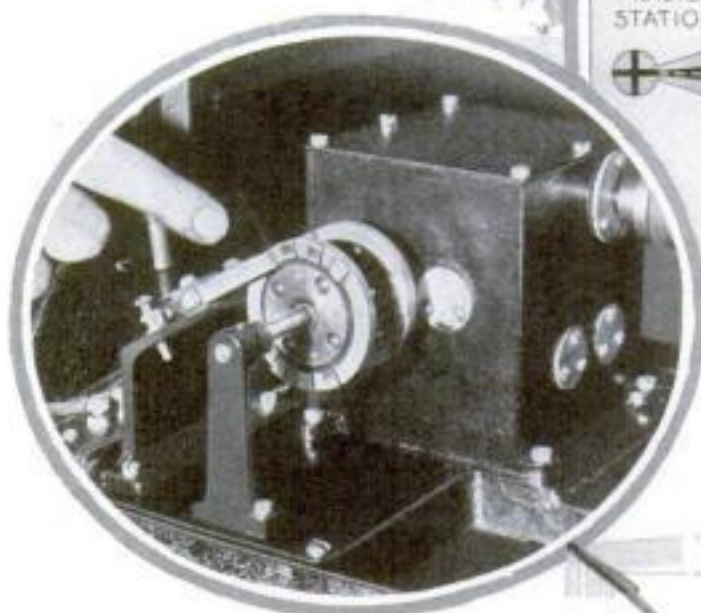
The question implied two facts. One: I knew permission would not be granted unless ceiling and visibility at Burbank, a hundred miles distant, were adequate to permit a safe descent through the heavy layer of fog. Two: Joe Ables, field manager at Burbank whose judgment would dictate the reply, knew I would not try to climb over the stuff unless I could see the top extended no higher than 15,000 feet, the highest altitude at which we can keep the passengers comfortable.

"Burbank to Bowman," came the reply instantly. "Just a minute."

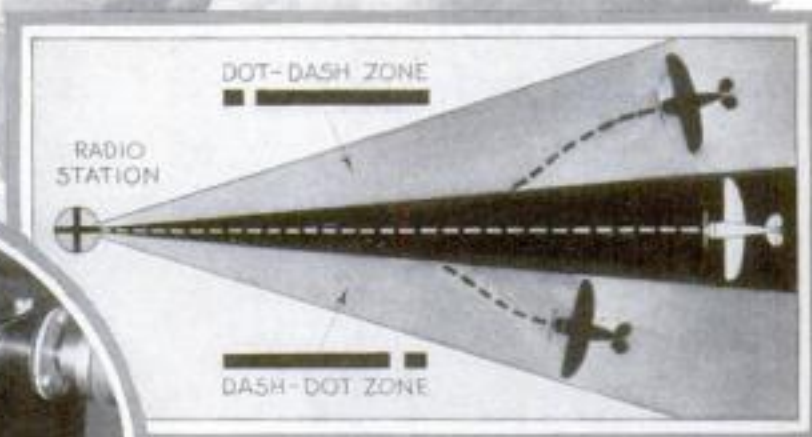
I waited hardly fifteen seconds before I heard Ables' sepulchral voice as it hurdled the mountains, penetrated the fog, leaped into my ears. In those few moments he had left his warm office and walked out onto the field where, as we say, he got fresh weather.

"Burbank answering Bowman," the voice said. "Permission granted to fly over the top to Burbank."

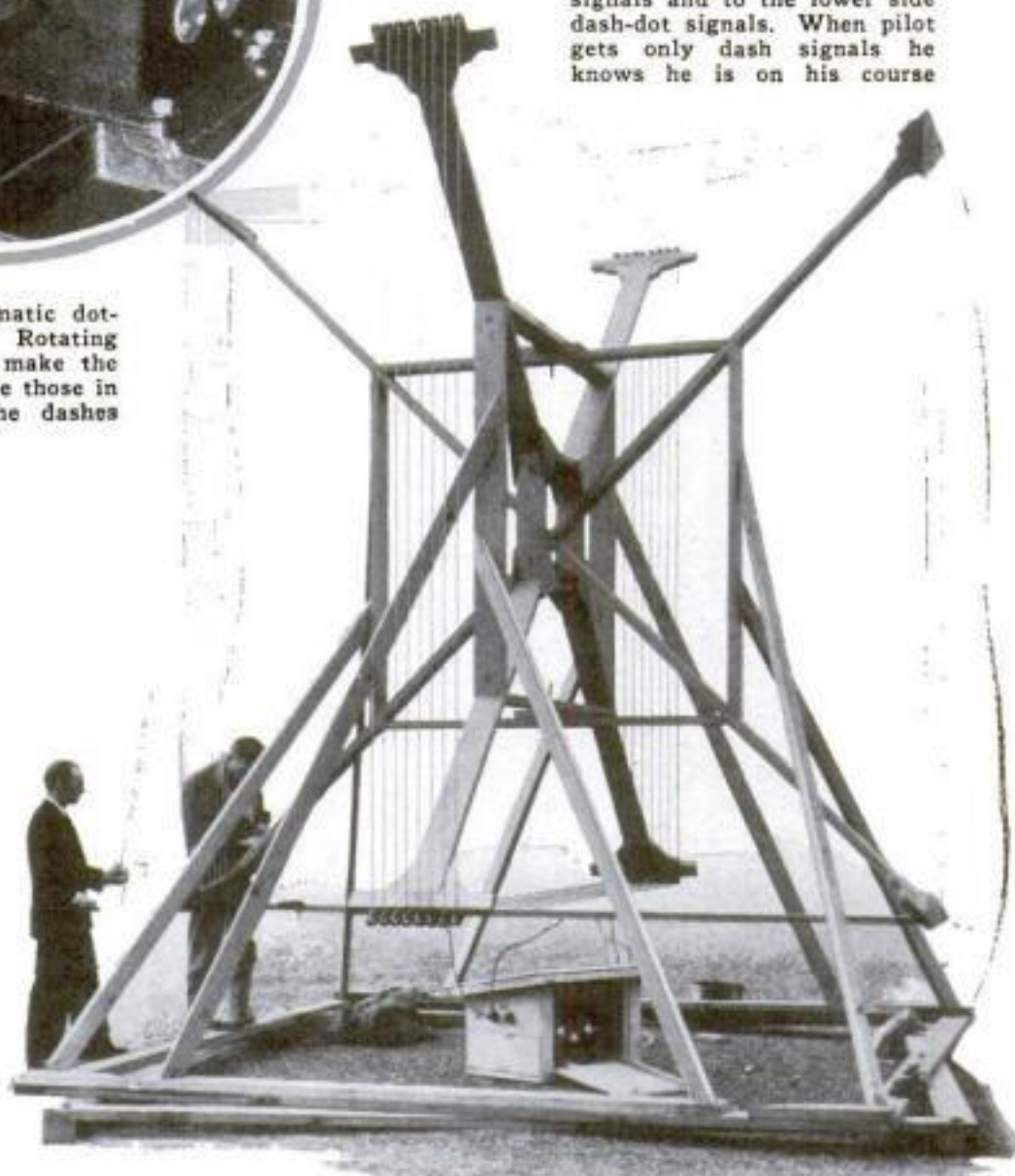
Over the top! Under a star-studded canopy of blue, over a billowing white floor. The world was hidden from view, but the voice of radio and the dots and dashes of the radio beam, told me constantly that I was flying on course, riding behind roaring motors to the brilliant lights



Here is the automatic dot-dash transmitter. Rotating contacts in front make the series of dots while those in back send out the dashes



To the upper side go dot-dash signals and to the lower side dash-dot signals. When pilot gets only dash signals he knows he is on his course



One of the aerials that are used in sending out directions by radio to pilots in an effort to guide them through fog to a safe landing

Transport Pilot, *Tells How He* *Through a Mile of Fog*

that in an hour would guide me undeviatingly to a landing.

Flying over the top with passengers at night when valleys and mountains are bathed in fog or washed by raging storms, no longer holds terror for pilots or passengers, for we do not carry them through the stuff or over it unless we know absolutely what lies ahead, behind, below, and on top.

I started climbing when Ables told me to come on over. I knew we'd need 13,000 feet to get over the hump, the forty-mile stretch of mountains that marks the Tehachapi separating southern California from the great San Joaquin valley. Ten minutes later, we left the moonlit valley and slid over the northern boundary of the fog, at last on top of everything with not even a land mark in view to guide me along the invisible route.

Pilots no longer need to navigate by following contours of the earth, by leaping goat-like from mountain-top to mountain-top. During clear weather, after long experience, we follow the compass and a sort of sixth sense in flying from port to port. At night, we grow to know the little light clusters that dot the surface of the earth wherever a town or village sleeps. But day or night, we need only tune to the beam frequency and signals from one of Uncle Sam's radio beam stations will drone in our ears and hold us to our course.

Usually it is comparatively simple to find the beam, as I did this night. I was flying slightly off course to take advantage of a stronger tail wind when Ables gave me the okay. Knowing I had swung off eastward, I turned the ship in toward the invisible path. In a couple of minutes familiar signals began to flow through my phones.

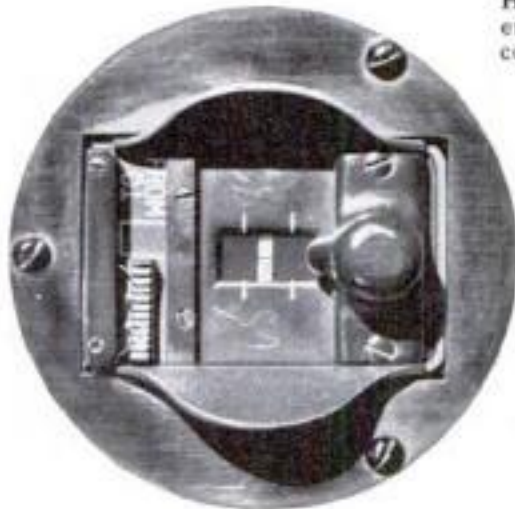
I banked and headed into the beam, moving gradually toward the right until I had entered the "on course" sector,



Bowman at the controls guides his plane down to landing field by radio signals



Here are the many instruments found on the modern plane. Every move made by the pilot is recorded so he always knows what his plane is doing



This instrument on pilot's instrument board shows two white vibrating reeds when the pilot is on the right course

DIRECTOR ON GROUND AIDS PILOT

With a phone at either ear, the man on the ground keeps in touch with the pilot and guides him safely down in spite of a mile-thick blanket of dangerous fog



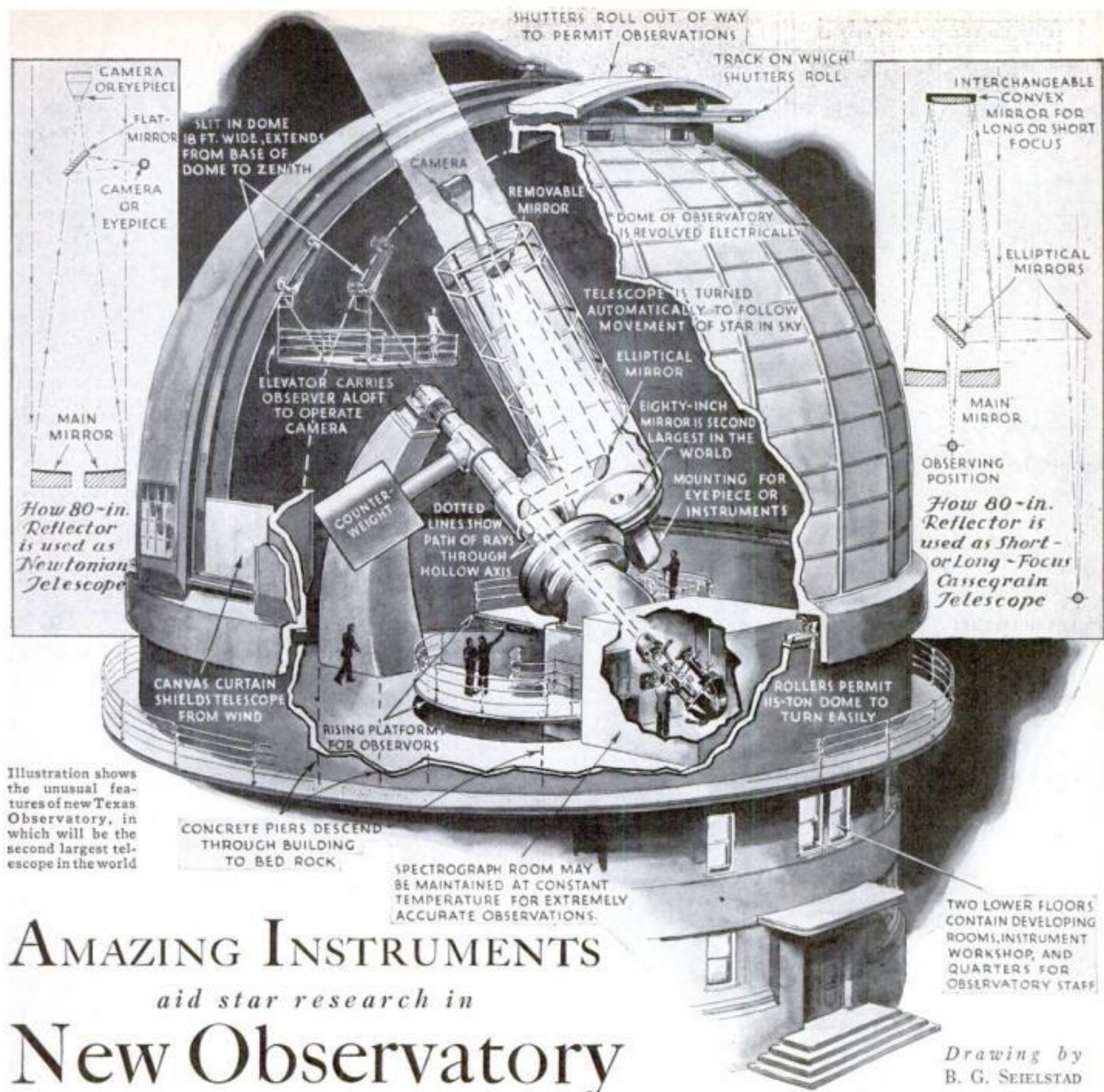
where the steady drumming of dashes told me I was headed directly toward the radio towers nearly eighty miles away.

Sometimes summer storms build up over the airways to considerable heights. On my own run, United Air Lines from San Diego to Oakland on the Seattle-San Diego airway, we may climb to 18,000 feet to escape them. Always, as on the night in question, we report our position every twenty minutes, either basing our estimate on some visible landmark, or, if all identifying peaks are obscured, on an estimate of our speed and drift from the last seen point or radio beacon.

Soon after I had begun to fly over the thick stuff, answering a position request from Burbank, I spoke again into the mike, that the ground crew might keep us spotted.

"Bowman in Marin," I said. "On Saugus beam . . . Estimated position over Lebec . . . thirteen thousand . . . solid overcast below . . . temperature thirty-two."

Freezing temperature, but ice cannot form unless sufficient moisture collects on the wings. And ice cannot collect when we fly in the dry air above moisture-filled fog and clouds. So we roared ahead through the night, passengers warm in the heated cabin, blue flames trailing the engines as we pushed across the mountains.



AMAZING INSTRUMENTS

aid star research in

New Observatory

SOON to rise upon Mount Locke in southwestern Texas, the great McDonald Observatory will represent the most modern achievement of the astronomical designer's skill. Plans just announced for its construction by Warner & Swasey Co., telescope builders of Cleveland, Ohio, for the joint use of the University of Texas and the University of Chicago, reveal that its monster eighty-inch reflecting telescope will be second in size only to the great 100-inch reflector at Mount Wilson, in California. Both the telescope and the observatory built around it will incorporate ultra-modern aids to astronomical research.

The telescope proper, a massive open framework of metal twenty-six feet long, supports the eighty-inch mirror at its lower end. This four-ton disk is to be cast of a standard make of heat-resisting glass, found in recent tests to be superior

to optical glass for the purpose because of its lack of sensitivity to temperature changes. Its grinding and polishing will be a delicate, two-year task. When it is in place, the great mirror will collect light from the stars and bring it to a focus with the aid of supplementary mirrors. How these may be interchanged to permit visual observation, photographs, and the use of special instruments at many places, is shown in the accompanying illustration.

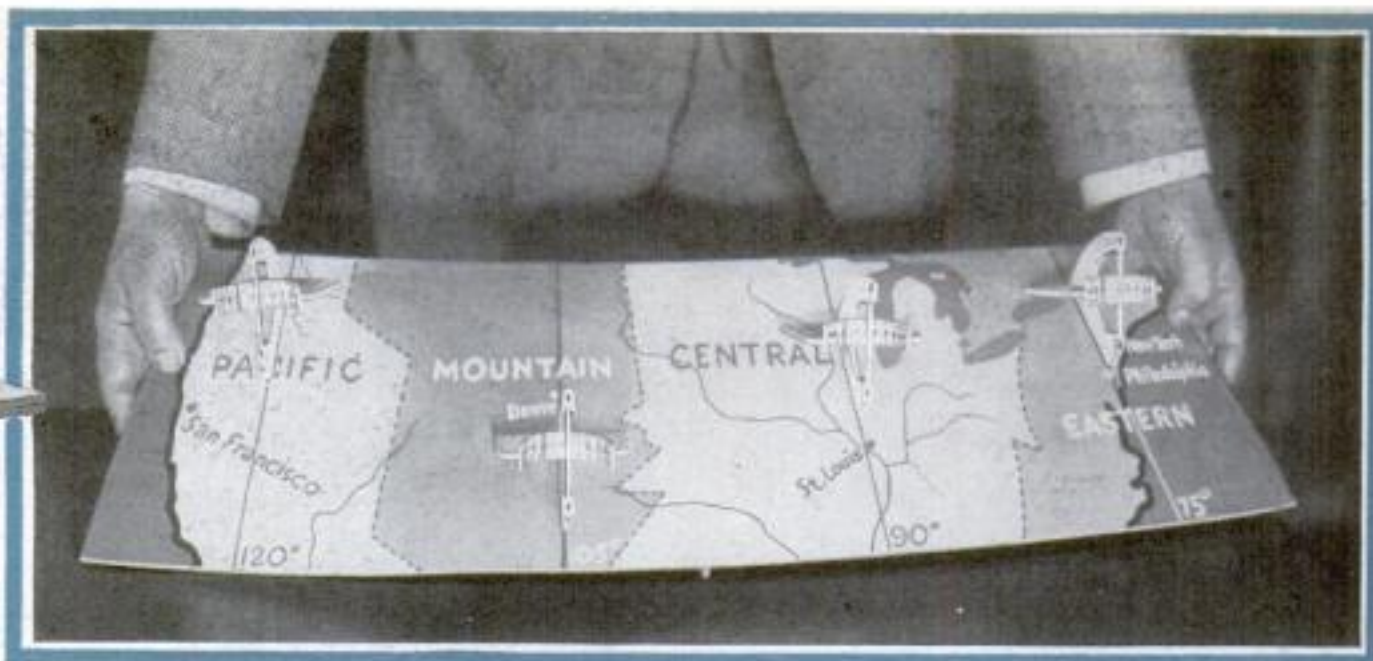
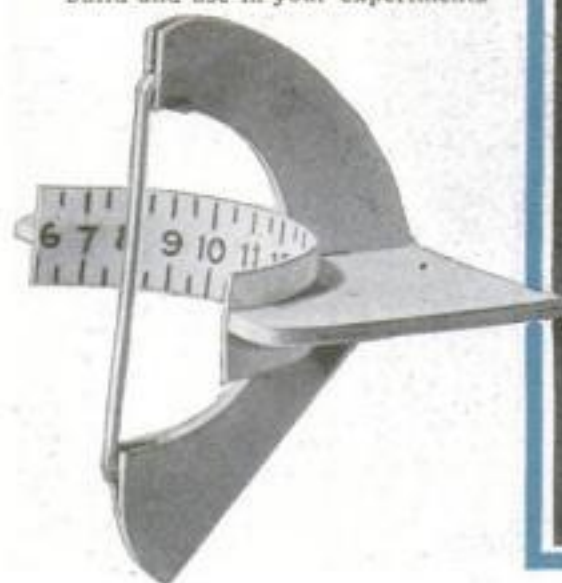
A hemispherical dome, sixty feet in diameter, weighing 115 tons, houses the big telescope. Despite its great weight, electric motors turn it easily upon roller bearings so the telescope may be trained in any direction through the fifteen-foot slit that extends from the base of the dome to its zenith. To guard the telescope from the weather, sliding metal shutters cover the aperture when it is not in use; and when the slit is open, a canvas curtain may be raised to prevent

wind from shaking it. Electricity automatically turns the telescope to follow the stars.

To enable an observer to reach the uppermost of the numerous points of vantage, an electric elevator, controlled by push buttons, carries him aloft along the circular girders of the dome. At the lower end, two movable platforms, electrically operated, rise or fall at the will of the observer. Another refinement is a spectrograph room in which the air may be maintained at a constant temperature, when this is required for extremely delicate observations. The wiring system is unique of its kind and contains four miles of electric wire.

Observing faint stars, distant nebulae and galaxies, and the spectra of stars will be the principal tasks of the new observatory. With the benefit of the most modern apparatus, its staff will be able to photograph stars a million times fainter than the unaided eye can see.

This sundial, which gives accurately the solar time, is easy to build and use in your experiments



On a curved map of the United States place sundials on the hourly meridians. Let a lamp bulb, acting as the sun, shine directly on the 75th meridian, at which point it is then noon. Move the map from west to east and you will see noon sweep west fifteen degrees each hour. This experiment shows the basis of our Standard Time

HOW TO CHECK UP ON

By
Gaylord
Johnson

TIME and the

ASTRONOMY is not merely a pastime for stargazing scientists. Instead, it is one of the most practical tools that man has made for himself and one that has aided human progress as much as have chemistry and engineering.

Without astronomy, ocean voyages would be so perilous the world would yet be largely unexplored. Without astronomy, time would still be measured by candles and water clocks.

Astronomy has gradually enabled us to understand the structure and workings of the wonderful machine we call the solar system. Little by little, man has come to understand what causes the varying lengths of day and night, the changing seasons, the tides, the eclipses, and all the other phenomena that puzzled and awed men 5,000 years ago.

As man's knowledge of the world in which he lives increased it became more nearly exact. For instance, hundreds of years ago men were satisfied to say that

the North Star marked the north pole of the sky. Now they know that the North Star revolves in a small circle around the true north point which marks the earth's axis.

To find this true north pole is of course necessary before an equatorial telescope can be mounted to follow the stars accurately. True north is also needed in order to mount a sundial properly. A simple experiment with two plumb lines will enable you to find and mark the true meridian once for all. This north and south line can be laid out upon the floor or roof, or across the top of a post outdoors or in any other convenient place.

If you decide to mark the meridian upon the floor, select a window facing the north, from which you can see nearly to the horizon. From a tack in the ceiling, or the window casing, hang a small lead weight. Let the little weight hang in a glass of water so that the plumb line will come to rest quickly and be less influenced by drafts of air. From a stick

supported by a small movable stool or pile of books on the table, hang another short plumb line. Now your apparatus is complete, except that a dim lamp or candle should illuminate the vertical cords so that you can see both of them and the stars at the same time.

Your problem is to move the stool until its short cord is in line with the longer cord and the polestar, and to do so at the exact time when the polestar is vertically above or below the true north pole of the sky.

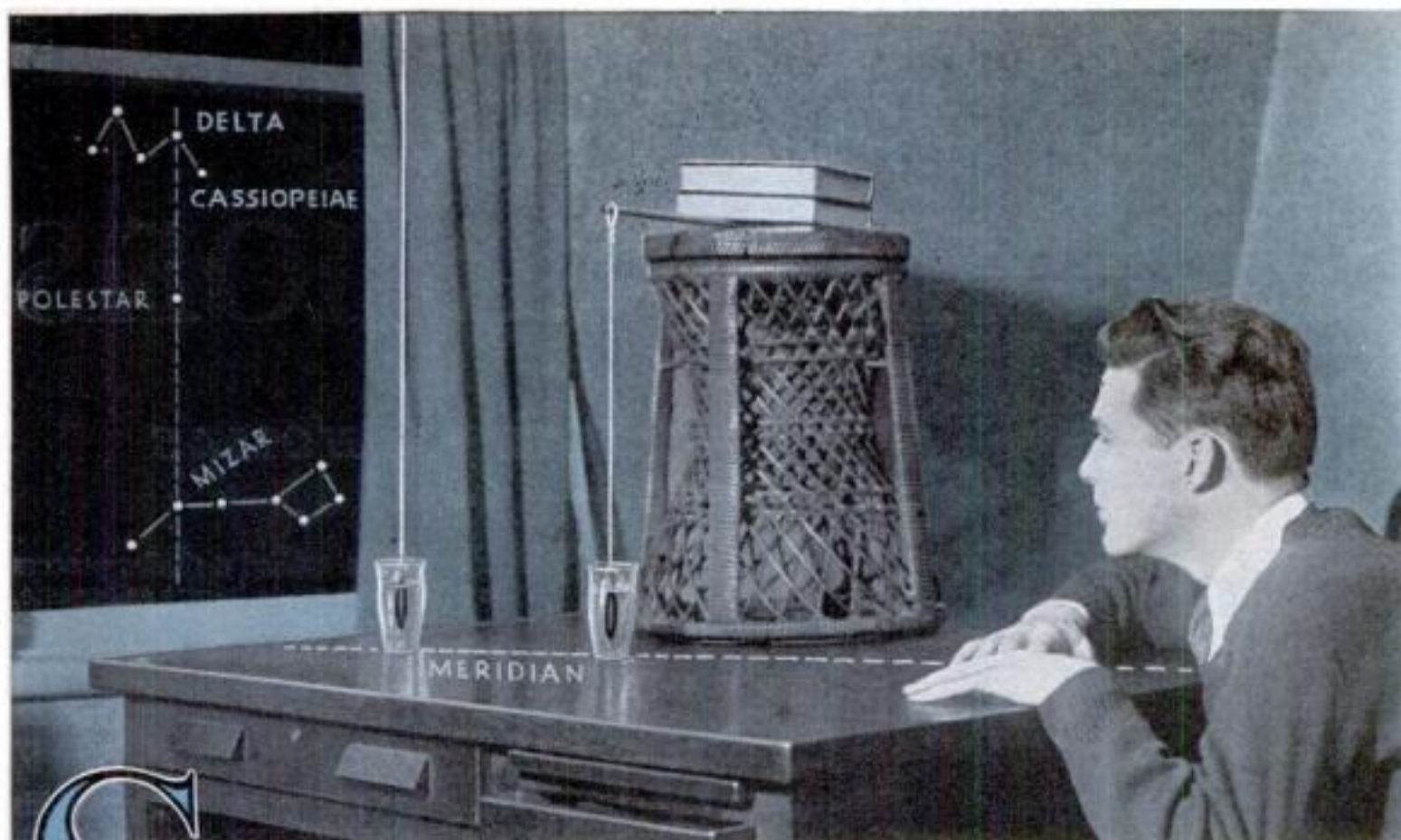
This is really easy to do, for the polestar is always vertically above the true pole when the star at the bend in the handle of the big dipper is vertically below the polestar.

During November and December, the Big Dipper is swinging across the sky below the polestar (P.S.M., May, '33, p. 46) at convenient evening hours, so all you have to do is to watch it until the star at the bend in the handle and the polestar are both in line with the long



WHY SUMMER IS HOT AND WINTER COLD

A globe, a flash light, and a piece of cardboard with a square hole cut in it, are used to demonstrate the heat of summer and the cold of winter. The light rays, hitting the globe vertically, as in the first picture, cover a small square and hence are intense. When the rays hit at an angle as in winter, shown in the second picture, they cover a rectangle. As a result they are diffused and so give out much less heat



To find true north, at this season, two plumb lines are dropped. They are then lined up with the polestar when it is vertically above the star at the bend in the dipper's handle. The plane joining the two plumb lines then points exactly north and south. In the spring and summer, it is more convenient to use Delta Cassiopeiae as this star then is vertically below the guiding North Star

Seasons

cord. Then shift the stool and the short plumb cord until the two cords coincide with the polestar, and rule across the table top a line joining the two cords. This true north and south line can then be transferred to the floor by plumb cords hung from the ends of the ruled line at the table edges. After this is done, you can set up your telescope at any time with its polar axis parallel to the meridian line on the floor.

This little table gives you the days and hours in November and December when the star Mizar, in the dipper's handle, is vertically below the polestar:

Nov. 5, 10:00 P.M.; Nov. 15, 9:20 P.M.; Nov. 25, 8:40 P.M.; Dec. 5, 8:00 P.M.; Dec. 15, 7:20 P.M.; Dec. 25, 6:40 P.M.

During spring and summer, you will find it more convenient to sight by the star called Delta Cassiopeiae, as the W-shaped group is then below the pole, with the dipper sailing high in the sky above it.

Now let us do an experiment that shows the difference between solar time (sun time) and standard time. It will also explain why almost the whole world uses the latter.

If you look at a globe, you will see a succession of straight lines ruled at equal intervals from pole to pole. There are twenty-four of them, corresponding to the twenty-four equal periods of time required for the earth to turn completely around on its axis. Since the earth's circle is 360 degrees, each meridian is fifteen degrees from the one following it.

As the earth turns eastward, the meridians pass successively into line with the sun. As the plane of each meridian crosses the center of the sun, it becomes noon at every point along that meridian, from pole to pole. If we like, we can therefore think of noon as a north and south line that moves constantly across

the sun-lit half of the world from east to west.

Now stop thinking about the earth as a whole. Consider only a strip of its surface extending across the United States. On a curved model of this strip the four hourly meridians crossing the United States are spaced fifteen degrees apart, and accordingly numbered 75, 90, 105, and 120 degrees respectively.

On each of these meridians, we place a small sundial and are ready to watch the noon line sweep across our miniature country!

To start with, we will hold the curved map about a dozen feet from a strong incandescent lamp, which represents the sun. Hold it first so that the shadow on the dial at the meridian of Philadelphia (the 75th) indicates twelve o'clock noon. Without moving the map, note that each of the shadows on the dials at St. Louis, Denver, and east of San Francisco indicates a time an hour earlier than the next one eastward.

Then rotate your body toward the east, moving the map slowly with it. You are turning the earth from west to east. As you do so, look down at the shadows on the dials and watch them shift. Soon the Philadelphia dial reads one o'clock and the noon line has moved on westward to St. Louis. As you turn farther, noon sweeps on to Denver and finally to San Francisco. When it is noon there, the dial

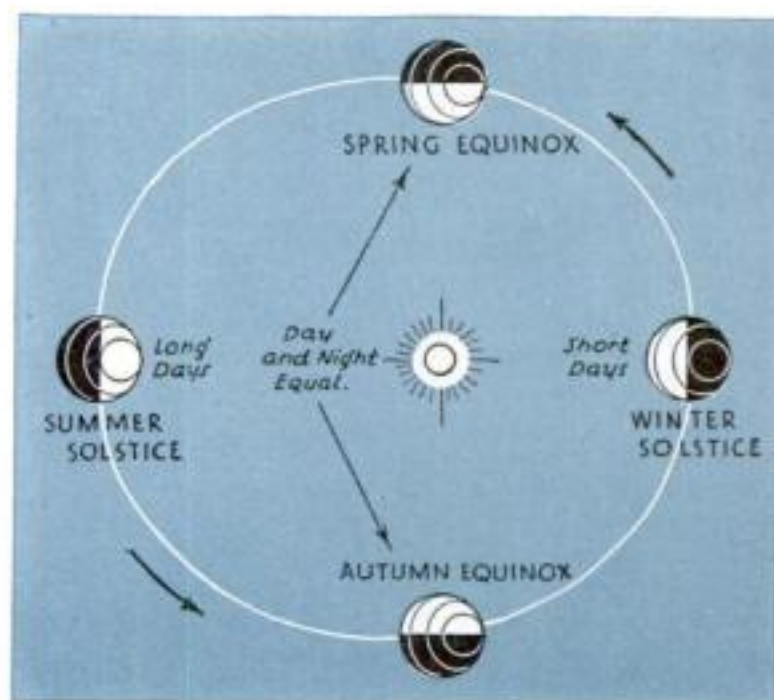


WINTER



SUMMER

Illustrations showing the position of the United States as seen from the sun in winter and summer. The difference is due to the north pole tilting away from the winter sun



EARTH'S ORBIT AROUND SUN

In its revolution around the sun, the earth moves farther from the sun in summer, as the illustration shows, and nearer it in winter. The inclination of its axis, however, turns the north pole toward the sun in summer and away in winter, causing long summer, and short winter, days

at Philadelphia will read three o'clock P.M.

As everybody knows, standard time also shows a difference of three hours between Philadelphia and San Francisco, so why wouldn't solar time do just as well? Why has standard time been established everywhere?

The answer becomes apparent when we compare the solar times of places less than one hour (Continued on page 103)

ACCIDENTS still produce Great Inventions

By EDWARD THOMAS



Far be it from me to advocate lingering over luncheon as a road to riches but one man made a fortune by doing just this

DAWDLING over his lunch caused a man to make a valuable invention and a comfortable fortune as well. This strange fact is revealed in a patent law decision just handed down by Judge John P. Nields, of the United States District Court of Delaware.

William H. Mason, the fortunate inventor, in an effort to produce, at low cost, a good, marketable paper, was experimenting with fibers made by exploding wood in an entirely original process.

Chemists had told him his fiber was useless for making paper because his process failed to eliminate the gummy substances called lignins which constitute half or more of the wood and seriously weaken any paper that contains them.

Mason, however, refused to listen to his chemical advisers and persisted in testing his process. In the spring of 1925, he shipped half a carload of his exploded wood fiber to a paper mill in Wisconsin, where he was allowed to treat his fiber by putting it through beating engines of various kinds. Among the machines he was permitted to use was a so-called Fourdrinier machine, in which the water carrying the fibers flows onto an endless belt that forms the paper sheet by draining off the water.

In one of his experiments, Mason made sheets out of his exploded wood fibers on the Fourdrinier machine and then placed the sheets, for thorough drying, between the steam-heated plates of a power-driven press. This method, he firmly believed, eventually would produce a strong, durable paper.

One day, while engaged in this particular test, he went out to lunch with one of the young engineers at the mill. Before leaving, he shut off the steam, or thought he did. Their lunch finished, the two friends for almost an hour sat chatting over the coffee cups. When they returned to the plant, Mason discovered that a steam valve had broken down and failed to shut off the steam when he had turned it before going out. As a result, the thick sheet of fiber, instead of being merely dried, had been baked for more than an hour by hot steam.

Mason thought the sheet must be spoiled but decided to test it before

throwing it away. To his astonishment and delight, he found that, instead of making paper, he accidentally had invented a fine, strong, and almost waterproof grainless wood.

Now Mason got busy in earnest. He screwed the press up to higher pressures, tightening it as the steam dried out the moisture, put fly-screen wire between the thick sheet and the metal plates of the press so moisture would escape easily, and modified the process in other ways. Finally, he found that he obtained the best results with the press exerting a pressure of between 200 and 700 pounds per square inch and the steam at a temperature of about 320 Fahrenheit.

He built a factory and, as the grainless board proved eminently suited to making door panels and many other carpentry and cabinet jobs, his product sold so well

that a rival firm applied a similar process to the sugar-cane waste known as bagasse, and sold baked bagasse board in competition with him. Mason sued for infringement, and Judge Nields has just decided in the rival's favor. But from all I can learn, Mason has nothing to worry about in a financial way.

This man, you might say, made his fortune by having a second cup of coffee. For had he returned promptly from his midday meal, he would have discovered the broken valve and probably would have shut off the steam just in time to prevent the fiber sheet from becoming a grainless board and himself from becoming a wealthy manufacturer. Far be it from me to advocate lingering over lunch as a road to riches. I pass Mason's story on to the readers of *POPULAR SCIENCE MONTHLY* because, in a quarter-century of practicing patent law, I seldom have come across a more striking example of accidental invention.

Of late, there has been a growing tendency to belittle the element of chance in the field of invention and discovery. We live in an age of coordinated effort. The poor, lone inventor hard at work in his garret laboratory has been all but relegated to the realm of fiction, and the belief is gaining ground that scientific and mechanical progress is largely a matter of the right kind of organization.

I know that this theory has yielded remarkable results. The work of the research staffs of the great concerns maintaining splendidly equipped laboratories for the purpose, produces thousands of patents each year. But I also know, from personal contact and observation, that the

HERE you have the dramatic story of great inventions born of lucky accidents and strange twists of chance. It is an inspiring account of inventors whose alertness enabled them to grasp mistakes and make them pay. A broken-down mixing machine, a cracked thermometer, a defective steam valve—out of such annoyances have come discoveries that made millions. The author of this article is a well-known patent attorney in New York City.



Alone in His Garret

The poor inventor, who worked single-handed in his tiny, dangerous laboratory has been relegated to the realm of fiction

number of fine inventions and discoveries made under the chaperonage of Lady Luck, is large enough to put new heart into the most discouraged inventor.

Paradoxically, a dramatic instance of chance taking a hand in the solution of a ticklish problem, occurred in one of the huge industrial laboratories to which I have just referred. This particular research staff at the time was working on the development of a quick-drying finish for automobiles, furniture, and other similar things.

Experiments had progressed to a point where the chemists knew they must use nitrocellulose as the basis of their mixture. But the concoctions they at first produced did not contain enough nitrated cotton to give them a lacquer with sufficient body to stand up under rough usage. The problem seemed simple: put in more nitrated cotton. The result was a jellylike mixture that would not spread.

For a while, the tests were abandoned. Then, one hot day, a new batch of the thick stuff was prepared and put in a big container, ready to go to the mixing machine. Just for luck, one of the chemists put some caustic soda into the mixture. But at the moment the jelly was about to be poured into the mixer, the machine broke down. The repair job took several days, during which the container with the compound stood forgotten in a corner of the laboratory.

When finally, the mixer again was in working order, the container was wheeled to the machine and the lid taken off. To the amazement of the staff, the jellylike mass had turned almost as thin and as clear as water. The stuff was tested and proved perfect for its purpose. A few days' time, some summer heat, and a pinch of soda had done what a laboratory-

ful of chemists had been unable to accomplish in several years of deliberate experiment.

The secret of making synthetic indigo from naphthalene was discovered in similar accidental fashion. Chemists working on this problem were stumped in their search for a catalyst that would produce the necessary oxidation. One fine morning, a young laboratory assistant, sticking a thermometer into a container filled

Another celebrated discovery (and, incidentally, another millionaire) was made because a chemist did not wash his hands at all. In the midst of an experiment, he happened to eat lunch at the shop one day without having made the preparatory trip to the spigot. Munching a roast beef sandwich, he noticed that it tasted sickeningly sweet, laid it down, and rose to get a glass of water. As he turned the tap, the thought suddenly struck him that he had forgotten to wash his hands. A careful examination of the materials he had handled just before eating, led him to the discovery of saccharine!

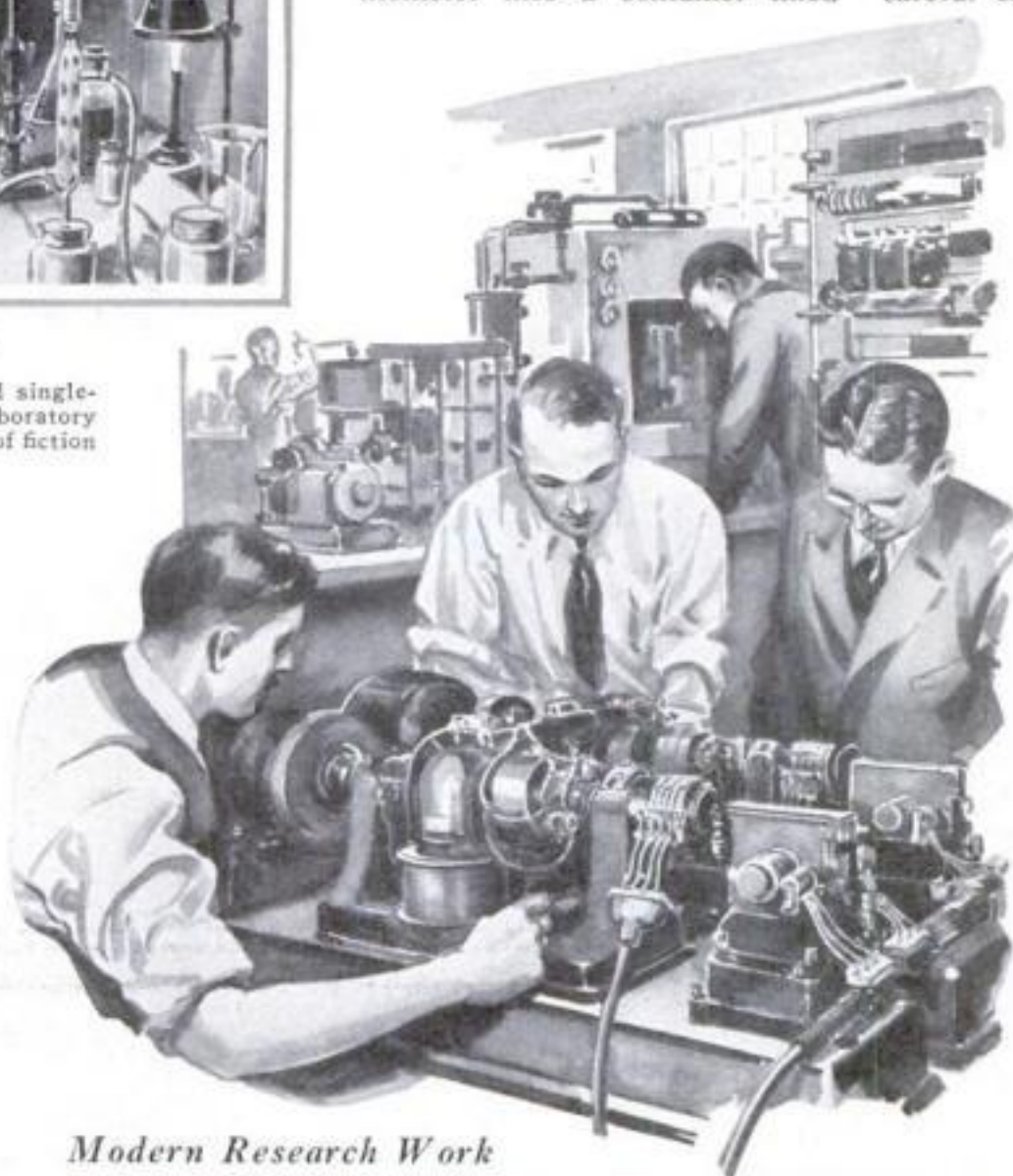
The lucky inventors of whom I have told you had one thing in common—they all knew a good thing when they saw one. Unfortunately, not everybody is blessed with insight, imagination, and the ability to seize upon a fluke and turn it to practical account. It is the possession of those qualities that spells the difference between a real inventor and a mere experimenter or tinkerer. It goes without saying that finding a diamond in the street wouldn't do you much good unless you recognized it as a precious stone instead of glass.

As everyone knows, Charles Goodyear discovered the process of vulcanizing rubber when he accidentally hit a hot stove with a mixture containing rubber and sulphur. He lost no time in getting a patent, and a watertight one, too. But the inventor who, seventy years later, discovered that rubber was enormously strengthened by mixing in a large proportion of carbon black, possessed neither the imagination

nor the smart business sense that characterized Goodyear. He did not realize the importance of his achievement and failed to get a patent. Hence no inventor has profited by so much as one cent from the discovery that a rubber tire will run 20,000 miles if the rubber in it contains forty percent of carbon black, while a similar tire made from rubber containing only five percent of carbon black will wear itself out in 5,000 to 10,000 miles.

The fortunate inventors I have mentioned had another thing in common. You doubtless have observed that, in each case, the invention was made in the course of another, sometimes unrelated, experiment. The majority of accidental inventions are made that way. It has, therefore, justly been said that this type of accident usually happens to those who deserve it; that is to say, those who, by much hard work and earnest thought, have prepared themselves for a visit of Lady Luck.

Thus it was while experimenting with photography that Daguerre left an exposed photographic plate in a closet that happened to contain an open dish of mercury, and *(Continued on page 101)*



Modern Research Work

Great commercial concerns maintain splendidly equipped laboratories and in them many thousands of valuable patents are being produced each year

with an unsatisfactory experimental mixture, accidentally broke the glass tube and the mercury ran out. Eureka! The desired chemical reaction occurred at once, and shortly afterward synthetic indigo was on the market.

Or take the way in which the first aniline dye from coal tar was made. For no particular good reason, the discoverer, a chemist named Perkin, believed that quinine could be extracted from coal tar. At the end of one of his many experiments, Perkin, perhaps for the twentieth time, found himself the discouraged possessor of a useless black mess. He was just about to throw it out in disgust when it occurred to him to add a dash of alcohol to the mixture. Instantly, the gummy mass of pitch assumed a brilliant purple color—and aniline dye was discovered by this unexpected accident!

Some months ago, I told the readers of this magazine (P.S.M., Aug., '32, p. 103) how the English mining engineer Cattermole, by observing how the dirty water behaved while he was washing his oil-stained hands without soap, accidentally discovered a new method of treating ores that later was developed into the famous and valuable froth-flotation process.

Biggest Sky Sign Flown by Autogiro



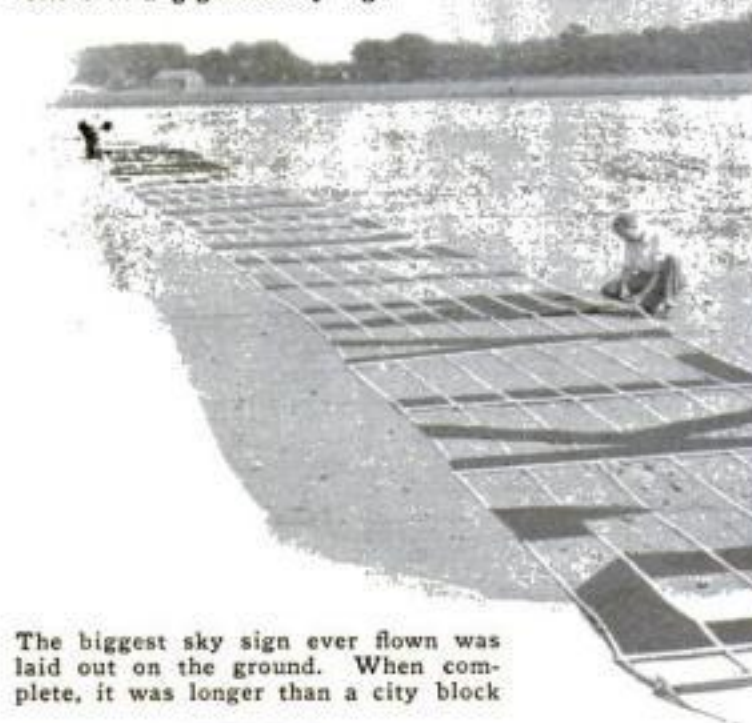
One of the bamboo poles and straps that held the nine-foot letters in a gigantic sky sign

WHAT is said to be the largest aerial sign ever towed into the sky was recently peeled from the ground at Curtiss Field, Valley Stream, N. Y., and flown over New York City. With letters nine feet high, it was longer than a city block. How the huge display was prepared and flown is shown by these photographs, made especially for **POPULAR SCIENCE MONTHLY**. The separate letters, each having a strengthening rod of bamboo or duralumin, are laid out on the ground and joined by

snapping buckles on fabric straps which run lengthwise of the sign. A 400-foot rope runs from the head of the sign down wind to the autogiro which is turned facing the breeze. When all is ready, the pilot climbs steeply into the air and flies back over the sign, which peels off the ground behind it, the end of the display leaving the ground last. In this manner, the letters are not dragged along the ground and injured. At the end of the flight, the rope is released by the pilot when a hundred feet above the field and the sign drops safely to the ground so it can be used again.



Autogiro, rising steeply into the air against the wind, raised the big sky sign behind it so the letters would not be dragged along the ground



The biggest sky sign ever flown was laid out on the ground. When complete, it was longer than a city block

HEAT CLOSES FIREPROOF SHUTTER

TO GUARD the archives and furnishings of the United States Capitol at Washington, D. C., against destruction by fire, the time-scarred wooden doors of the building have just been replaced throughout by fireproof doors of the latest type. The new-style door is of metal construction with a ventilating panel that ordinarily remains open. In case of fire, however, a fusible link melts and allows a steel shutter to drop in place over the panel, barring the passage of the flames. The photograph shows David Lynn, whose official title is Architect of the Capitol, examining one of the new doors and the fusible link that operates it. The link has been detached and placed beneath the steel shutter for inspection, as is clearly seen in the picture.



David Lynn, Architect of the capitol, Washington, D. C., examines a fireproof steel door



- 1 Driest fine
- 2 Fine
- 3 medium fine
- 4 medium
- 5 medium heavy
- 6 Heavy
- 7 Bold
- 8 Heavy bold
- 9 EXTRA BOLD

Moving the slide up or down on this pen point makes it fine or coarse, as samples above clearly show

POINT ON NEW FOUNTAIN PEN CAN BE MADE FINE OR COARSE

AN ADJUSTABLE point that writes in nine degrees of fineness is the feature of a new fountain pen of well-known make. The adjustment is made by moving a slide up or down along the point, which varies its flexibility. Besides being able to suit the point to his own handwriting the user can adapt it to fine writing.

CARBON ON DISKS MAKES COPIES OF TYPEWRITING



This attachment, consisting of swinging arms and disks of carbon material, does away with the necessity of using carbon paper to secure desired copies of typed letters



Close-up showing how the carbon disk is inserted between sheets to secure copies

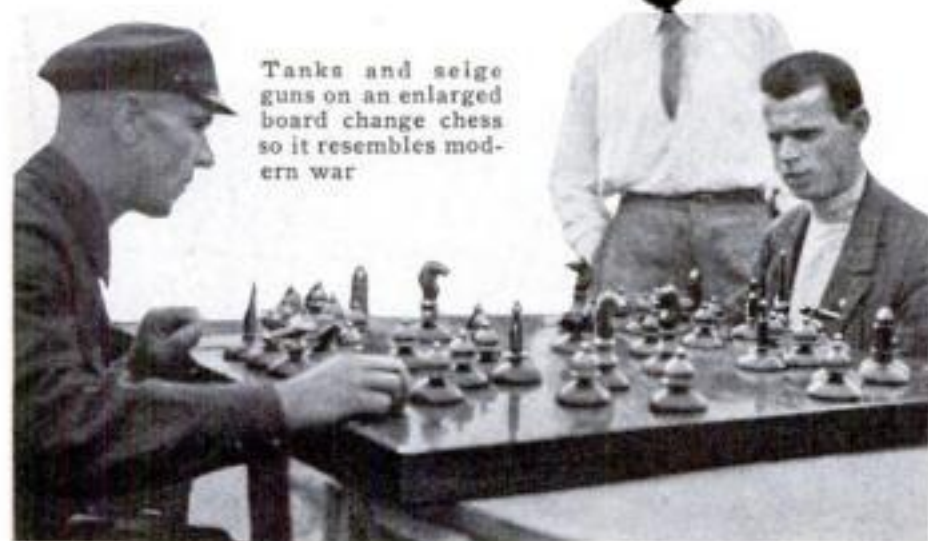
EASILY fitted to any typewriter, a new device eliminates the use of carbon paper, and its attendant muss and inconvenience, in making copies of letters and business forms. It comprises a series of swinging arms, each one bearing a replaceable disk of special carbon material, mounted on a frame that can be attached to the machine or detached in a few seconds. As many disks are inserted between the sheets as copies are desired. Each disk revolves as the typing proceeds, continually presenting a fresh surface. When the typing is done, the disks are swung out of the way and a perfect set of copies is immediately at hand, without need of separating them from sheet carbon. If at any point in the typing it is desired to omit prices or other data from one or more copies, a touch on any one

of a set of keys at the top of the attachment flips the corresponding disk out of writing position, as shown above.

DOUBLE CHESS BASED ON MODERN WAR

"AIRPLANES" replace queens and "general staffs" play the part of kings in a new pastime known as "double chess." Devised by a Russian inventor, A. C. Yurgelevich, the game is gaining popularity in that country. It is derived from chess, but the rules and strategy have been modified. The appearance of the pieces has been changed and the board has been trans-

formed in order to modernize the game and simulate present-day warfare. To make room for an up-to-date military campaign, the board contains double the customary number of spaces. Gone are the old pawns, rooks, bishops, and knights; their places are taken, respectively by "soldiers," "heavy artillery (symbolized by thick cartridges)," "machine guns (represented by slender bullets)," and "cavalry." A new piece, known as a "tank," has been added. The object of the game is to destroy the active forces of the enemy and to capture or declare checkmate against the hostile general staff. Each of the pieces have powers of movement and destruction according to its specific function in actual warfare.



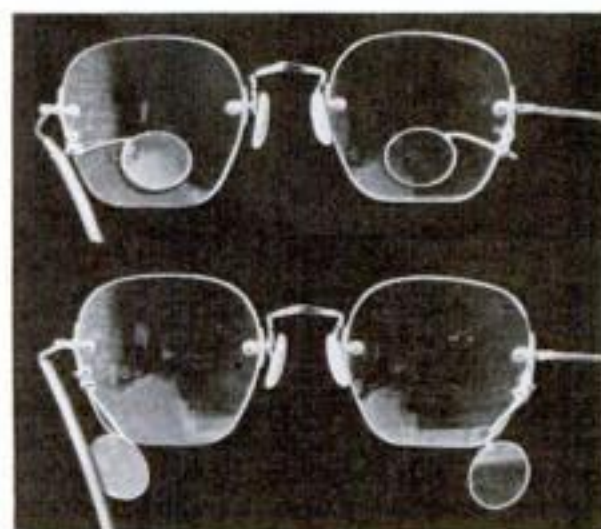
Tanks and siege guns on an enlarged board change chess so it resembles modern war



Pressing a button opens this mailbox and a spring within it then delivers the letters

BUTTON OPENS MAIL BOX AND DELIVERS LETTERS

WHEN his mail box broke, an inventive Cleveland, Ohio, man decided to make a new one himself—and to improve on the old one. The result is a box that may be opened, after unlocking, simply by pressing a button. An inner container springs up in response, bringing the mail with it. To close and lock the box, the container is pushed back into place. When the box is locked, the button may be struck hard without opening it.



These two views of convertible spectacles, show them with the reading lenses swung aside and also in the bifocal position

SPECTACLES ADJUSTABLE FOR FAR OR NEAR SIGHT

CONVERTIBLE spectacles, instantly adjustable for near or far vision, are the invention of a Chadron, Neb., optometrist. For close work such as reading, writing, or sewing, a small auxiliary lens is swung in front of the main one on each side. Mounted on pivoted arms, the movable lenses are easily pushed out of the line of vision when not needed. Thus the user may look straight ahead at all times, instead of being obliged to tilt his head as with the ordinary bifocal glasses. According to the inventor, the supplementary lenses may be attached to any spectacles thus changing ordinary street glasses into those that are suitable for reading and other short-distance work.

Microscopic Marvels

YOU CAN FIND IN *Your Workshop*



SPARK DUST

At left, a file is being held against an emery wheel. The sparks that fly off are caught in a paper so they can be placed beneath a microscope's lens. In the circle, how the spark dust appears when enlarged about 50 times. Below, emery wheel dust and steel pellets, the twisted fragments being the steel

be directed into the paper, and continue grinding until you have a little pile of dust.

Place a small amount of the dust on a glass slide and put it carefully on your microscope stage. Adjust your lenses for a low power, say thirty to fifty times, bring your homemade illuminator into action, and look into the eyepiece.

You will see little angular pieces that look like irregular jewels when illuminated from almost any angle. They are particles from the wheel, and are either dark or light in color, depending on the kind of abrasive used. Mixed with them are ragged, twisted pieces of metal, chips torn off by the thousands of sharp teeth on the wheel face. Here and there, you also will see little globules or spheres. Perhaps their surfaces are smooth and shiny; perhaps they are pitted. They are tiny bits of metal that, when molten, you saw as sparks flying off from the wheel. It is these pellets that are proving of importance in the steel industry.

Metallurgists at a large manufacturing company discovered that there is a definite relation between the form of the grinding wheel pellets and the composition of the steel that produced them. It happens that steels, difficult to classify by the spark test, can, in many cases, be identified by examination of their pellets.

PERHAPS the chief reason why the use of the microscope is growing in popularity as an instructive and fascinating hobby is that it makes two worlds visible where only one was seen before. This is true of any shop, whether it be your own place in a corner of the basement or a unit in a giant factory.

Visit your workshop or that of a friend. Look about you. There are lathes, power saws, drill presses, hand tools of all kinds, scraps of iron and steel, a pile of lumber, and a box full of odds and ends. Your interest in these things is determined by your knowledge of their purposes and the manner in which they are used.

Now take your microscope into the same shop and peer through it at the various things you find there. You will discover beauty in the scrap box, romance in a rusty piece of steel, a fascinating story in the dust that collects around a grinding wheel, mountain ranges on a file, and a host of other things that you never even dreamed were there. The microscope, in fact, proves that every shop is really two: the normally visible one of tools, steel, and wood; and the one of cells, crystals and particles that is revealed by your microscope.

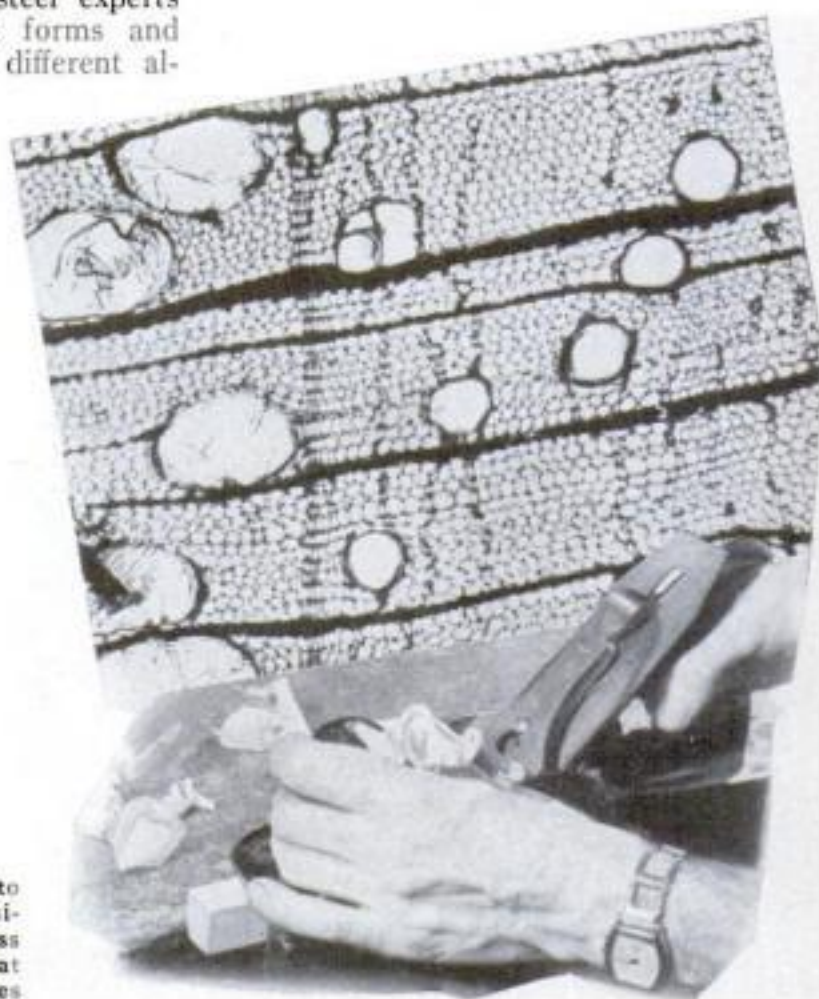
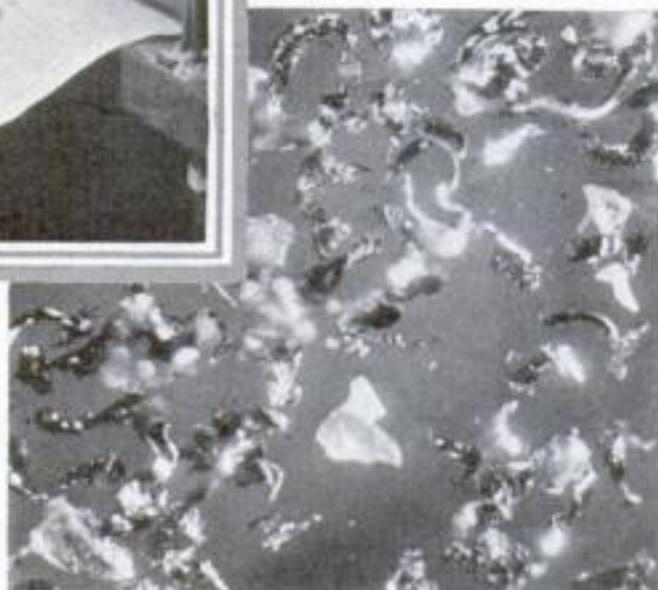
When you grind a piece of metal on

an abrasive wheel, showers of beautiful sparks fly off. For years, steel experts have been observing spark forms and colors and thus identifying different alloys. But the method has its limitations, for some metals defy identification in this way.

With your microscope, you are prepared to follow the steps of metallurgists who, not long ago, found a way of going the spark system one better. Place in front of the grinding wheel, a sheet of newspaper folded so that it will catch the dust driven off when you grind a piece of steel. Select a piece of metal that will produce sparks generously, such as an old file. Hold it against the wheel so that the spark shower will

HOW YOU CAN STUDY WOOD

Right, a plane may be used to get wood sections for the microscope. Above it is a cross section of black walnut that is enlarged about 60 times





LOOKING AT STEEL

Above, polishing a steel pipe cap with emery and powdered rouge is the first step in preparing it for the microscope. At extreme right, etching steel with nitric acid to bring out the crystals. In circle, specimen held to stage of instrument with rubber band. Note, light that is used is nearly vertical



By
**MORTON C.
WALLING**

How Experts Mount Specimens and Identify Metals by Their Crystals and Woods by Their Cell Structure

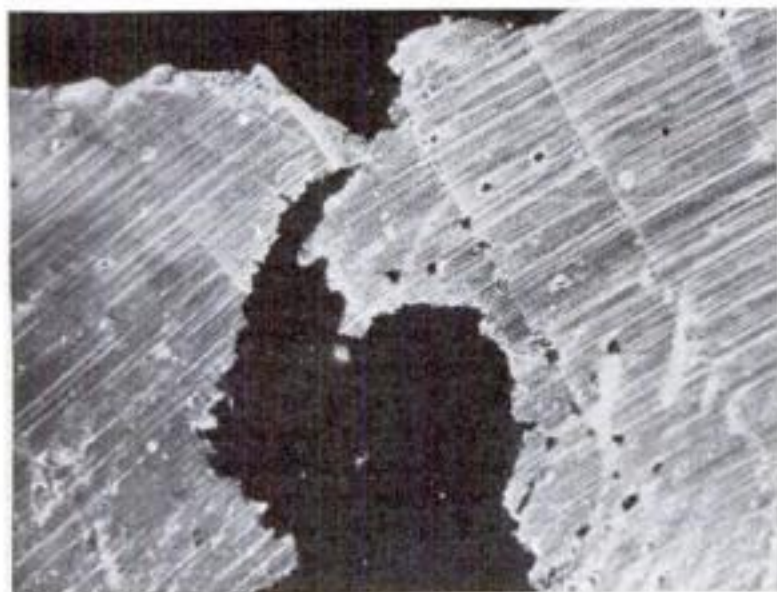
You can have a lot of fun collecting pellets from different kinds of metal objects and looking at them through your microscope.

Even if your instrument is not a very powerful one, it will show you the structure of metals just as the expert microscopist in a steel plant laboratory sees them. The microscope is largely responsible for development of metals and alloys that make possible the automobile, airplane, and almost every other piece of modern machinery. Under its revealing eye, the crystalline grains of metal are as plain as the bricks in a pavement.

Iron and steel being the most common workshop metals, you doubtless will want to examine them first. If specimens of them are prepared in the manner about to be described, their structures can be seen with a relatively low-powered microscope.

Nearly pure iron exhibits beautifully the crystalline grains that make up metals.

This cross section of white pine, enlarged by microscope's lens, gives a good view of its annular rings and resin ducts



These grains, when the metal has been polished and etched lightly with a chemical, are outlined by fine lines. Further etching results in a change in color and tone of various crystals. Still deeper etching often brings out the three-dimensional form of the crystals.

Metallurgists have given names to the various things that can be seen in a piece of iron or steel. If you examine wrought iron, you will see dark streaks or spots extending through the crystals. These are slag particles, elongated by pressure used in shaping the metal piece. Some carbon may be present, but it, in union with other materials, is found between the crystals rather than inside them.

Mild or low-carbon steel is nothing more than wrought iron from which the slag has been removed. In structure, low-carbon steel is a mass of carbonless iron crystals, which the metallurgist calls ferrite, with here and there between grains, dark patches containing the carbon. These patches sometimes shimmer in the light like mother-of-pearl, which is the reason the substance forming them is called pearlite.

When sufficiently magnified, these pearlite spots are seen to contain alternate dark and light streaks or plates. These may be about 1/25,000 of an inch thick. The dark streaks are ferrite or iron which has been stained by the etching solution. The light streaks are iron carbide or cementite. It is interesting to note that genuine mother-of-pearl is made up of layers of thin plates that reflect light in a striking manner.

As the amount of carbon

in steel is increased, the areas of pearlite become larger and the grains of ferrite smaller until, when the amount of carbon is nine-tenth percent, the steel is all pearlite.

The preparation of specimens of iron and steel for study is not complicated. You will be wise to start with cast iron, because it responds readily to the treatment. Later, you can tackle more difficult material.

Although many steels have to be heated to about 1,800 degrees Fahrenheit and then cooled slowly in order to remove strains and make the structure uniform, you will not have to do anything of the sort to cast iron.

File or grind the surface to be etched, until it is bright and smooth. Then polish it with abrasives of increasing fineness until the metal has a mirror-like appearance. You can use emery paper for rough polishing, starting with a fine grade, and finishing with the finest you can get. Another way is to make a lap by tacking a layer or two of broadcloth over a wood block, wetting the cloth, and sprinkling fine powdered emery over it. For final polishing, use powdered rouge and a lap similar to that employed for emery.

The next step, after carefully washing and drying the polished surface, is to apply the etching solution. Its action on the metal surface causes the grain structure to become visible. Some parts are attacked more extensively than others. Also some of the materials in the metal are colored differently from others. There are several different kinds of etching solutions that you can prepare.

One reagent consists of five grains of picric acid in about three and one half ounces of absolute alcohol. Immerse the metal for thirty seconds.

Another *(Continued on page 92)*

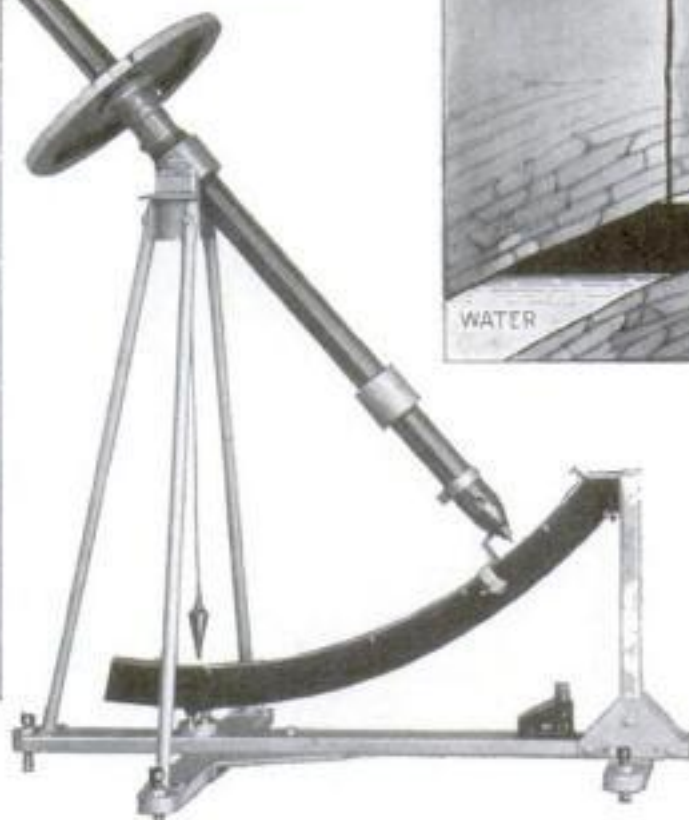
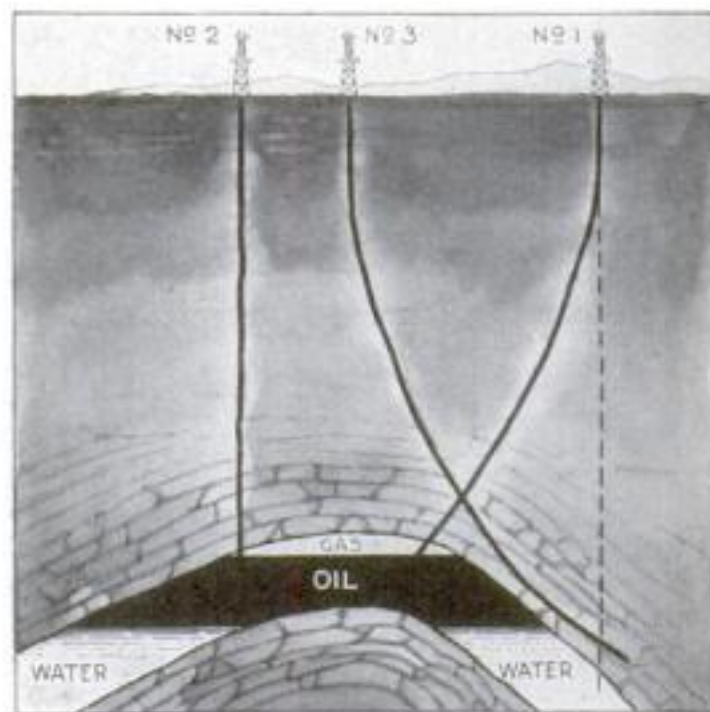
New Tools Straighten Oil Wells



As the pipe is lowered into the oil well its position is determined by means of the underground survey instrument which makes an accurate record of any deviation from the exact perpendicular

Tiny Camera Now Makes Underground Surveys

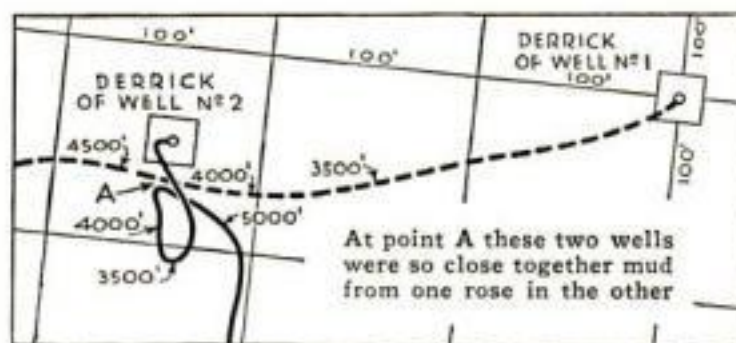
Below, the underground survey instrument is being tested for accuracy before it is placed in a well. At right, note how two wells failed to go down straight, one of them missing the oil completely. It is to prevent this that the survey device is now being widely used



TO SOLVE a perplexing mystery, Alexander Anderson, petroleum engineer of Fullerton, Calif., was called not long ago to a western oil field. Two wells put down in a promising area had struck oil, and the producers, rejoicing at their success, had drilled a third well between the two. Strangely enough, although they added section after section to the string of pipe that rotated the drill, the well did not produce oil. According to theory, oil must be there but it seemed impossible to find it with the third well.

Into each well, in turn, Anderson lowered a long, slim instrument resembling a gun shell. It contained a photographing surveying apparatus that recorded at various depths the tilt of the hole. Its disclosures were surprising. The first well drilled should never have struck oil at all, and wandered by chance into the reservoir. Well No. 2 went straight down to the oil as a good well should. Well No. 3 started all right, and then veered off on an erratic slant that took it entirely out of the producing area.

Wandering oil wells are now a recognized problem of the oil fields, for it is hard to keep a hole going straight as far as a mile or more below the surface. Cases are recorded where a pair of wells, started as far as 2,300 feet apart, have actually run into each other in the depths of the earth, and mud from one has entered and come up the other.



At point A these two wells were so close together mud from one rose in the other

To enable drillers to keep their shafts straight, a remarkable method of subterranean exploring has been devised by Anderson. It uses three ingenious devices known as the "underground survey instrument," the "single-shot magnetic survey instrument," and the "go-devil."

The underground survey instrument gives a complete survey of the well from top to bottom. When its waterproof shell is up-ended and lowered into the hole, a photographic film automatically starts moving downward past an aperture where a flashing light beam registers periodic marks upon it. The beam is directed upon the film by a multiple swinging mirror, hung like a pendulum, so that the resulting film record will show the tilt of the instrument when each flash occurred. By timing the descent of the instrument with a watch, as the measured string of pipe is lowered with the instrument from the mouth of the well, the surveyor is able to know when the instrument reached each depth level and consequently at what

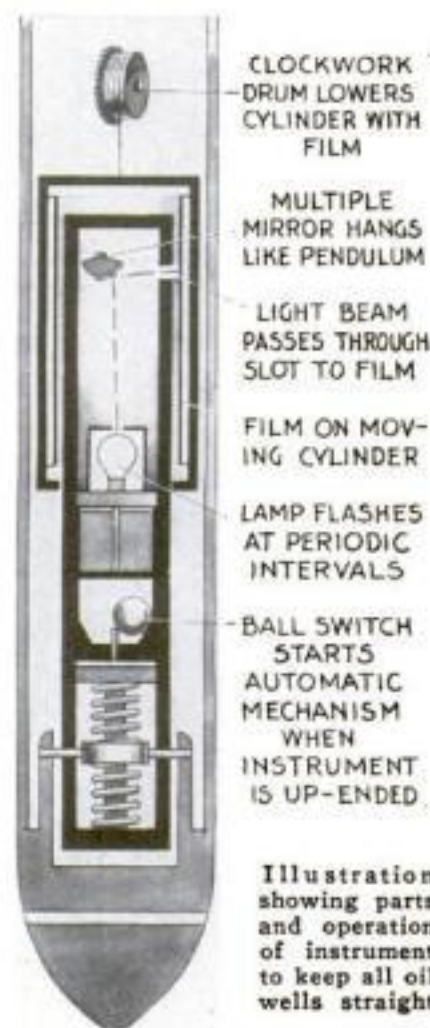


Illustration showing parts and operation of instrument to keep all oil wells straight

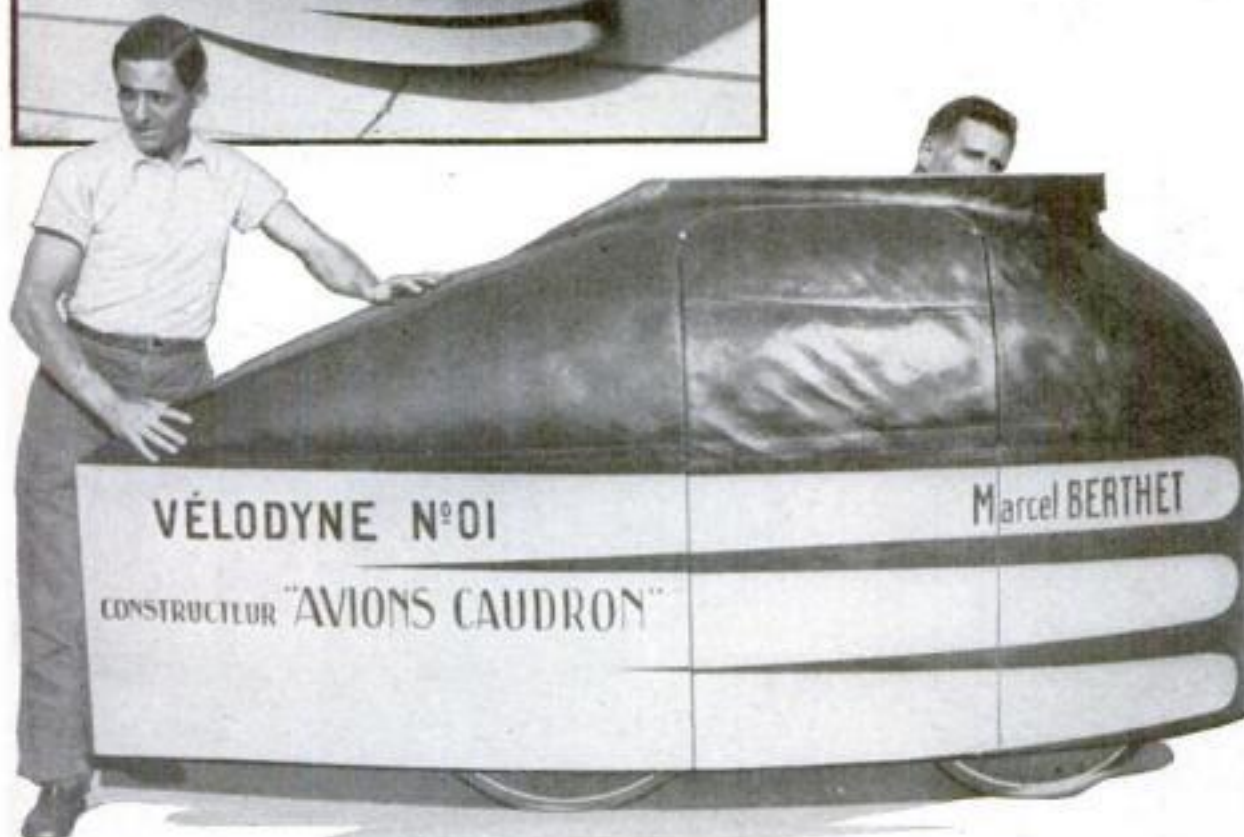
depth each of the marks registered on the film was made. The resulting film shows every turn and twist of the well.

If a reading is desired only at one certain depth, as an occasional check in drilling a new well, the magnetic survey instrument is lowered on a cable to the bottom. After a pre-determined time, a clock closes an electric contact that forces a pair of plumb bobs against a pair of composition disks that record the angle of tilt. At the same time four magnetic compasses are clamped to lock their reading. The go-devil is a similar instrument, but the plumb bobs are actuated by a trigger from a grease chamber, controlled by applying pressure at the mouth of the well. Through the use of these instruments, wells are accurately surveyed.



BICYCLE IN STREAMLINED SHELL AIMS AT MILE-A-MINUTE SPEED

This streamlined shell is said to make it possible for bicyclists to travel at speeds up to sixty miles an hour. It was designed by Marcel Berthet, champion rider of France



BELIEVED to be the fastest man-propelled vehicle in the world, a streamlined bicycle has been devised and named the "velodyne" by Marcel Berthet, French cycle champion. With this machine, the inventor declares, a cyclist can easily attain speeds of forty miles an hour, and can even exceed a mile a minute for brief spurts. The rider enters the "tear-drop" shell through a door cut in the side, and gets under way with his head lowered below the level of an aperture at the top. A small rectangular peephole cut in the front, at eye level, provides forward vision. Since the rider is almost completely inclosed in the streamlined fairing, which presents a frontal width of barely two feet, wind resistance is reduced to a minimum. The design of the "velodyne" was worked out according to aerodynamical principles with the assistance of Marcel Riffard, chief engineer of a prominent French airplane firm.

TRAFFIC LIGHTS FOR BRITISH PORT

TRAFFIC lights to control the movements of boats entering and leaving a harbor are an innovation successfully tried in England. The lights have been installed at Yarmouth, British seaport and center for herring and other fishing industries, and enable big liners and about 2,000 herring boats using the same river entrance to operate without interference. Visible two and a half miles away, the signals direct the comings and goings of the fishing fleet. The lamps are installed on the harbor master's home.



These lights guide ships in and out of Yarmouth harbor



CYCLISTS' MOLDED MASKS

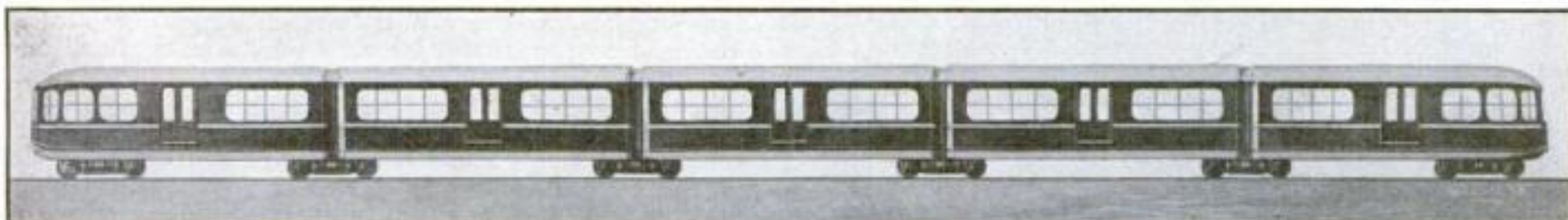
FOR races on cinder tracks, daredevil New York motorcyclists wear grotesque masks to protect their faces against flying particles from the wheels of each other's machines. The racers dip the masks in water to soften them and then press them against their faces. When dry, the masks take on the contours of the cyclists' features. Goggles are worn over the eye-holes. In addition, the racers wear football helmets to guard their heads.

FIVE-SECTION, ALUMINUM SUBWAY CAR IS NOISELESS

SWIFT and virtually noiseless, a rapid-transit car of radically new design has been perfected for service on elevated and subway lines through the joint research of several of the country's leading manufacturers of railroad and electrical equipment. The new car is 170 feet long, made of aluminum alloys similar to those used in airships, and is divided into five articu-

lated sections with vestibules giving access from one to another. Since its weight is only half that of the whole train that it replaces, it can be started and stopped more rapidly and can therefore run on a considerably faster schedule. Despite the cars' rapid pick-up to its full speed of fifty miles an hour, an automatic electrical control makes the increase in

speed so smooth that passengers who are standing will not be thrown from their feet or suffer any inconvenience. An improved system of gearing, using roller bearings, banishes noise from worn gears. Now under construction in Chicago, the first multi-section car of the new design is expected to be placed in experimental service on a New York elevated line.



This radical rapid-transit car is to be tried out in New York. It will be 170 feet long and will make 50 miles an hour

Homemade Shaking Platform

HELPS STUDY OF EARTHQUAKES

INTERESTED in a description he read in this magazine of a "shaking table" in use at Stanford University for studying the effects of earthquakes with model building (P.S.M., April, '33, p. 16), Cedric W. Richards, architectural student at the University of Nebraska, resolved to construct a working model of the Stanford apparatus. Aided by his father, he built the ingenious miniature shaking table pictured here. An electric motor spins an unbalanced "flywheel," a bar of iron an inch square and six inches long, mounted at one end, to give the nineteen-by-twenty-four inch platform a continuous oscillating motion. Single shocks of any desired magnitude are given the platform by dropping a heavy, pivoted hammer against a coil spring at its end. Models of building frames are mounted on the platform, which rolls on four wheels along a steel track, so that their sway in response to the vibrations may be demonstrated. An automatic machine, somewhat resembling a seismograph, records the intensity and duration of the shocks to which they are subjected. While Richards built his device primarily as an exhibition model, he believes that it can readily be adapted to useful scientific research in the investigation of earthquakes and the vibration caused by heavy traffic.

This homemade table, shaken by a motor, is used to study the effect of earthquakes on various buildings



CAMERA GUIDES SHIP THROUGH FOG



With this camera, pictures are made by infra-red light and developed within thirty seconds. They guide a ship through heavy fog

GUIDING a ship by taking pictures of the outlook ahead is the method proposed by Capt. F. M. Williams, former naval officer, to combat fog at sea. During a recent voyage of the liner *Manhattan* he demonstrated his "invisible-ray camera," designed for the purpose, which makes photographs by means of the fog-penetrating rays of infra-red light. Developed immediately, the pictures can be viewed within thirty seconds after exposure, and are said to show objects four and a half times as far away as the eye can see. The invisible-ray camera would be especially useful, its inventor declares, in negotiating a narrow and tortuous channel or harbor entrance obscured by fog. The accompanying photograph shows two models of the instrument being tested.

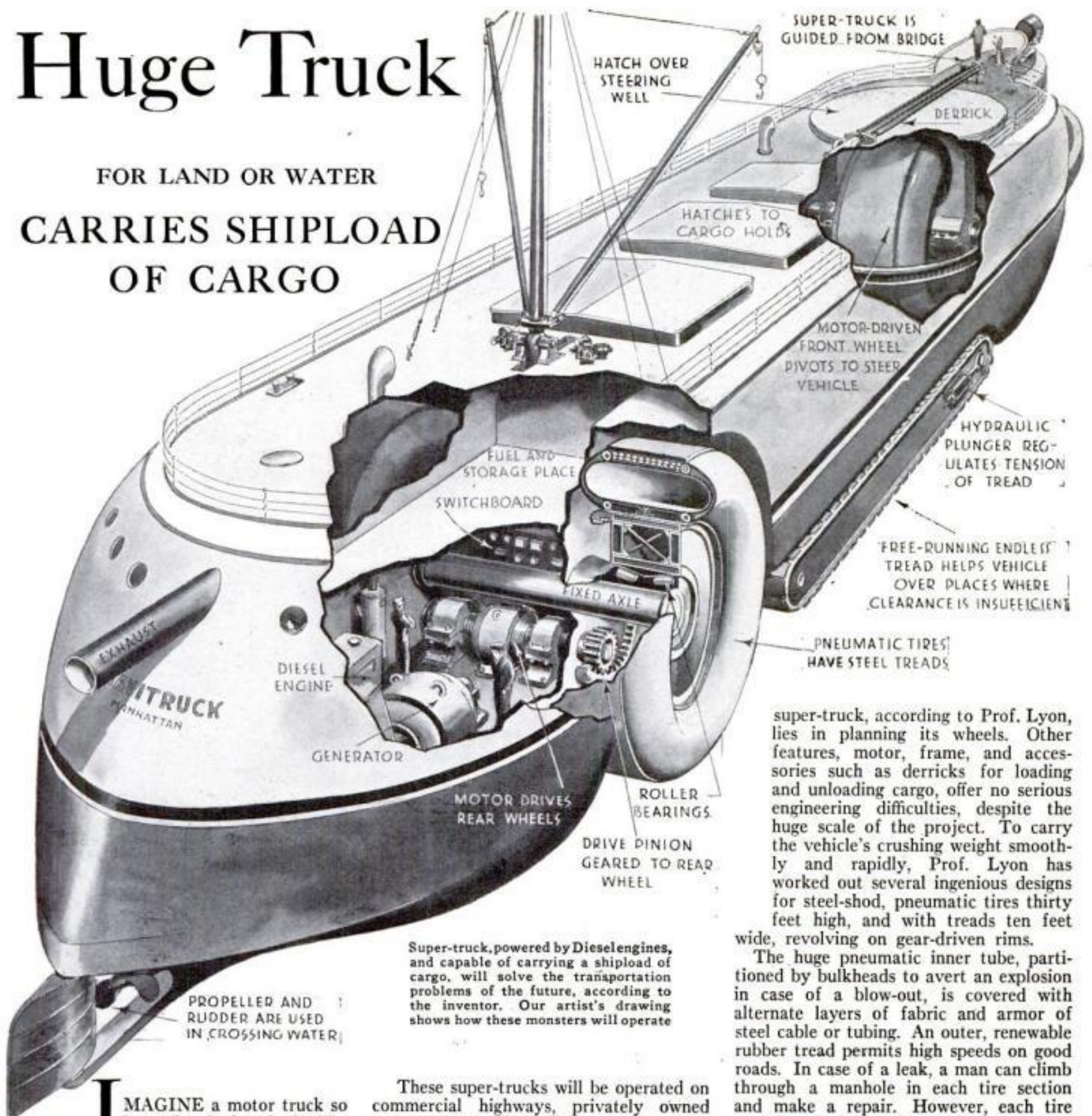


DIRT IN CAR'S OIL SEEN WITHOUT AID OF EXPERT

ANY motorist may see for himself, without consulting a service-station attendant, whether the oil in his car's crank case is dirty and needs changing, if he uses a demonstrating device intended for service stations. A sample drop of oil from his car's crankcase, is placed on a white card, clipped to a slide, and inserted in the instrument as shown above. Then, when a button is pressed, a flashlight bulb illuminates the card and specks of dirt or bearing metal are made plainly visible to the motorist himself through a magnifying eyepiece at the top.

Huge Truck

FOR LAND OR WATER
CARRIES SHIPLOAD
OF CARGO



Super-truck, powered by Diesel engines, and capable of carrying a shipload of cargo, will solve the transportation problems of the future, according to the inventor. Our artist's drawing shows how these monsters will operate

IMAGINE a motor truck so large that it dwarfs the biggest locomotive in the world—a veritable ship of the land, rolling on pneumatic tires as high as a bungalow. Fit this juggernaut, in your mind's eye, with a boat-like hull, a Diesel motor, and an electric drive; add a propeller and rudder so that it can navigate in the water as well as on dry ground; fill its capacious hold with hundreds of tons of cargo, and send it roaring across the continent or through a wilderness to its destination. Then you will have a mental image of the 1,500-ton, amphibian super-truck that Eric R. Lyon, associate professor of physics at the Kansas State Agricultural College, predicts will be the freight-carrying vehicle of the future. To prove it feasible, he himself has worked out the engineering design of such a machine, which he calls the "navitruck," and which our artist illustrates here and on the cover of this issue.

These super-trucks will be operated on commercial highways, privately owned and operated, Prof. Lyon foresees. The roads, needing only to be sanded or graveled, can be constructed at one-third the cost of building a railway. No bridges are required; the super-trucks will ford all streams. In a real sense they will be "land ships," since each one carries as much load as a fair-sized cargo vessel; and both the operating plans and the freight charges will approximate those of water-borne shipping.

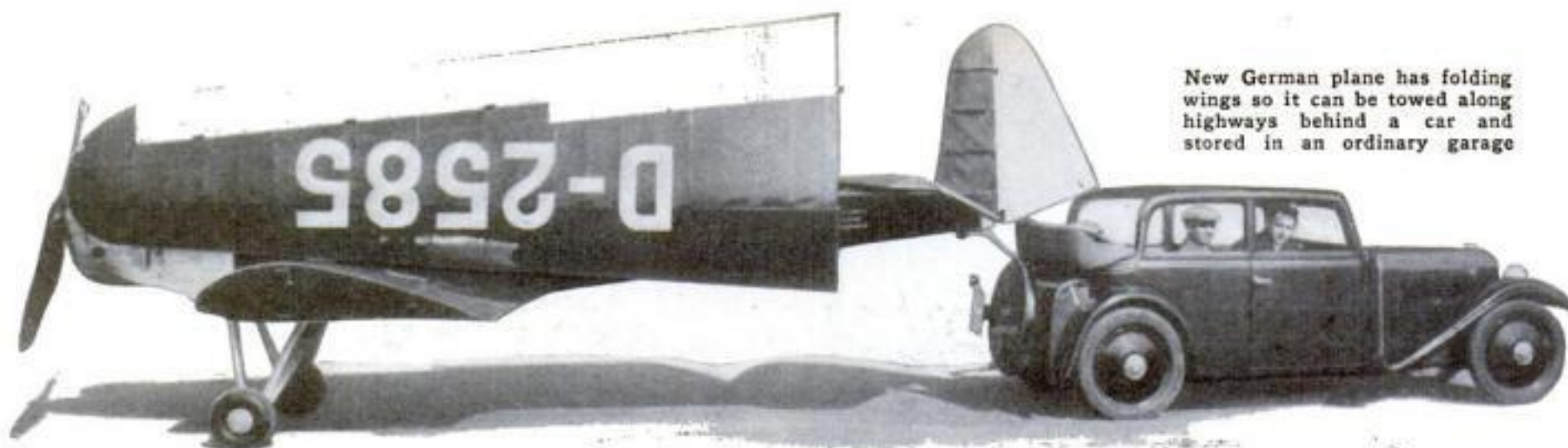
Super-trucks will prove their worth especially in the western United States, Prof. Lyon predicts; while they also offer a means of opening inaccessible regions of Canada, Asia, Africa and South America, rich in mineral and other resources, to commerce. A sloping prow at the front of the machine will serve as an ice-breaker, or will clear the way over infrequently-traveled trails through tropical jungles.

The principal problem in projecting a

super-truck, according to Prof. Lyon, lies in planning its wheels. Other features, motor, frame, and accessories such as derricks for loading and unloading cargo, offer no serious engineering difficulties, despite the huge scale of the project. To carry the vehicle's crushing weight smoothly and rapidly, Prof. Lyon has worked out several ingenious designs for steel-shod, pneumatic tires thirty feet high, and with treads ten feet wide, revolving on gear-driven rims.

The huge pneumatic inner tube, partitioned by bulkheads to avert an explosion in case of a blow-out, is covered with alternate layers of fabric and armor of steel cable or tubing. An outer, renewable rubber tread permits high speeds on good roads. In case of a leak, a man can climb through a manhole in each tire section and make a repair. However, each tire contains an automatic electric compressor that will maintain the required sixty pounds' pressure despite all but the severest leaks. An auxiliary endless tread amidships helps the super-truck over obstacles in its way.

Roads suitable for the super-trucks will be forty feet wide for one-way traffic and eighty feet wide for two traffic lanes, Prof. Lyon estimates. They will be easy to maintain in good condition, since the massive wheels of the monster truck act as road-rollers and pack the surface more firmly each time they pass over it. Super-highways of this type will be constructed, Prof. Lyon predicts, radiating from Denver, Colo., to Duluth, Minn.; to Kansas City, Mo.; to Galveston, Tex.; and, by way of Santa Fe, N. M., and Phoenix, Ariz., to Los Angeles, Calif. He also predicts a super-highway for the giant trucks from Canada to Mexico by way of the 100th meridian.



New German plane has folding wings so it can be towed along highways behind a car and stored in an ordinary garage

Flivver Plane, with Folding Wings, Is Towed to Air Field

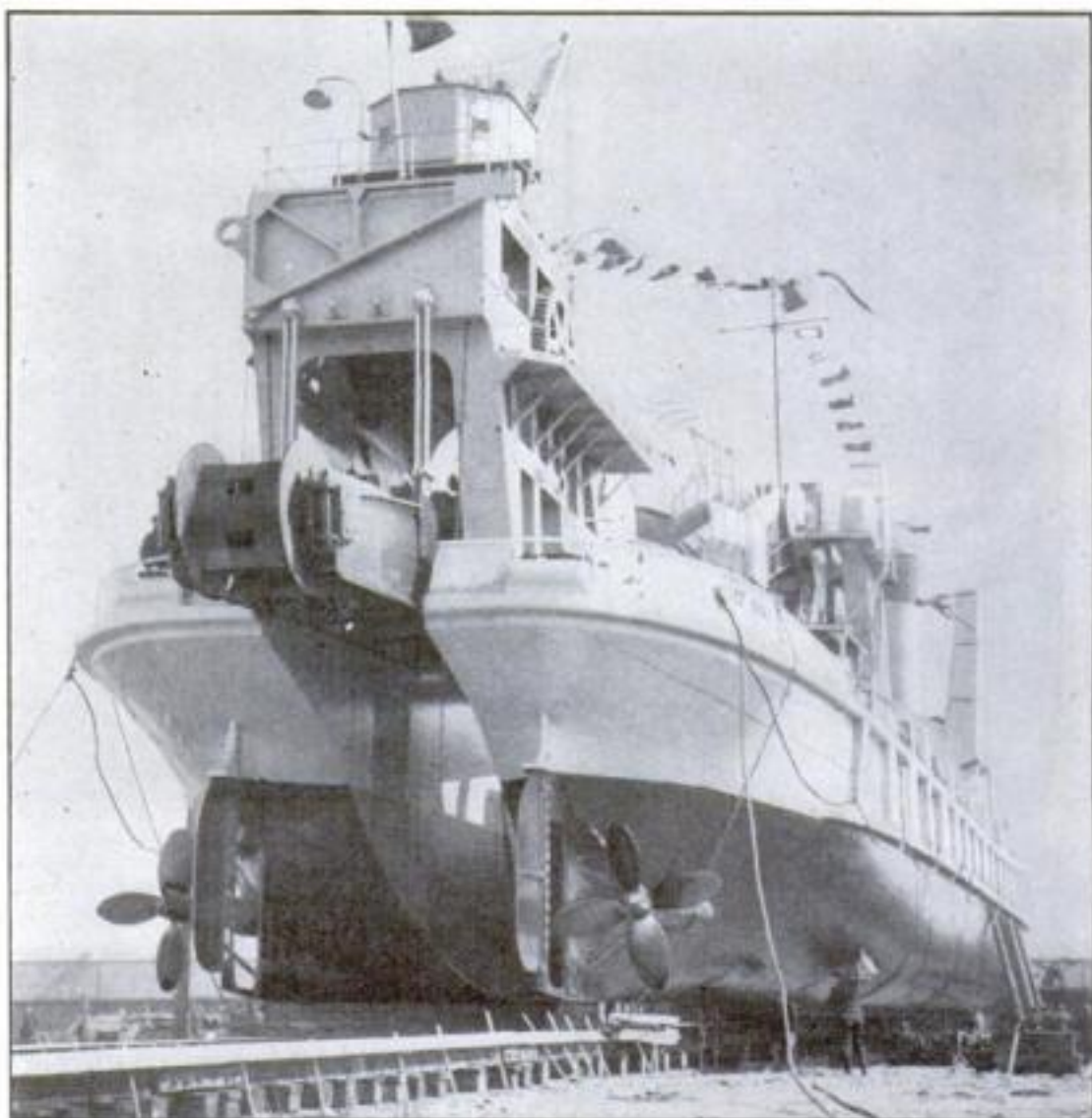
INTENDED especially for the amateur pilot, a new type of light plane, developed in Germany, is designed to be towed by an automobile to and from the flying

field. The wings fold so that the machine offers no obstruction to traffic while it is on the highway, and it may be stored at home in an ordinary garage. In the air,

the plane can attain a speed of sixty-five miles an hour. It is expected to be marketed at \$700 and its designer says it may be the air flivver of the future.

WORLD'S MIGHTIEST DREDGE TO CLEAR FRENCH HARBOR

RESEMBLING a vessel sliced in two, the world's most powerful dredge, named the *Pas-de-Calais II*, was launched at Dunkirk, France, the other day. Its endless chain of buckets is lowered through a well that extends from amidships clear to the stern, and can scoop up mud from as far as seventy-five feet below the surface, at the rate of nearly 800 cubic yards every hour. Each minute, fifteen buckets take their bite out of the bottom. The first task of the big vessel, which measures 236 feet in length and forty-three feet in width, will be to improve the harbor of the French port of Boulogne-sur-Mer. At present the vessel is designed to burn pulverized coal, but a later installation for fuel oil is contemplated.



Natives in the jungles of British Guiana protect themselves from the sun beneath big umbrella leaves

UMBRELLA LEAVES WORN IN JUNGLE

WHEN natives of British Guiana jungles find the sun's rays too warm, they have only to break off the huge leaves of the umbrella tree and drape them over head and back. This photograph depicting their style in sunshades was made during a recent expedition, headed by Andre LaVarre, through the interior of Brazil and Guiana. In the background of the picture, the Kaieteur Falls, a wonder of nature seldom viewed by white men, rush over a precipice 741 feet high, which is four times the height of Niagara Falls.



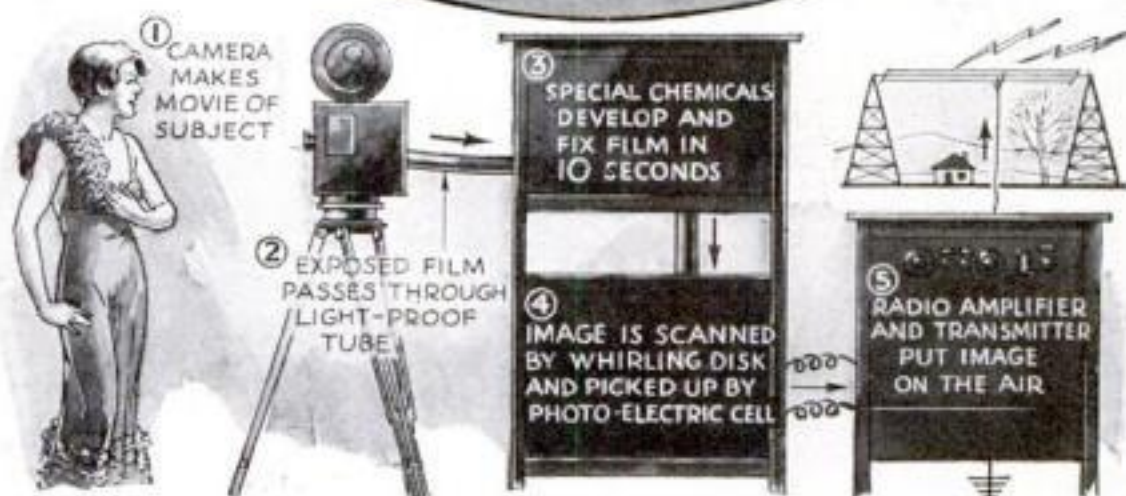
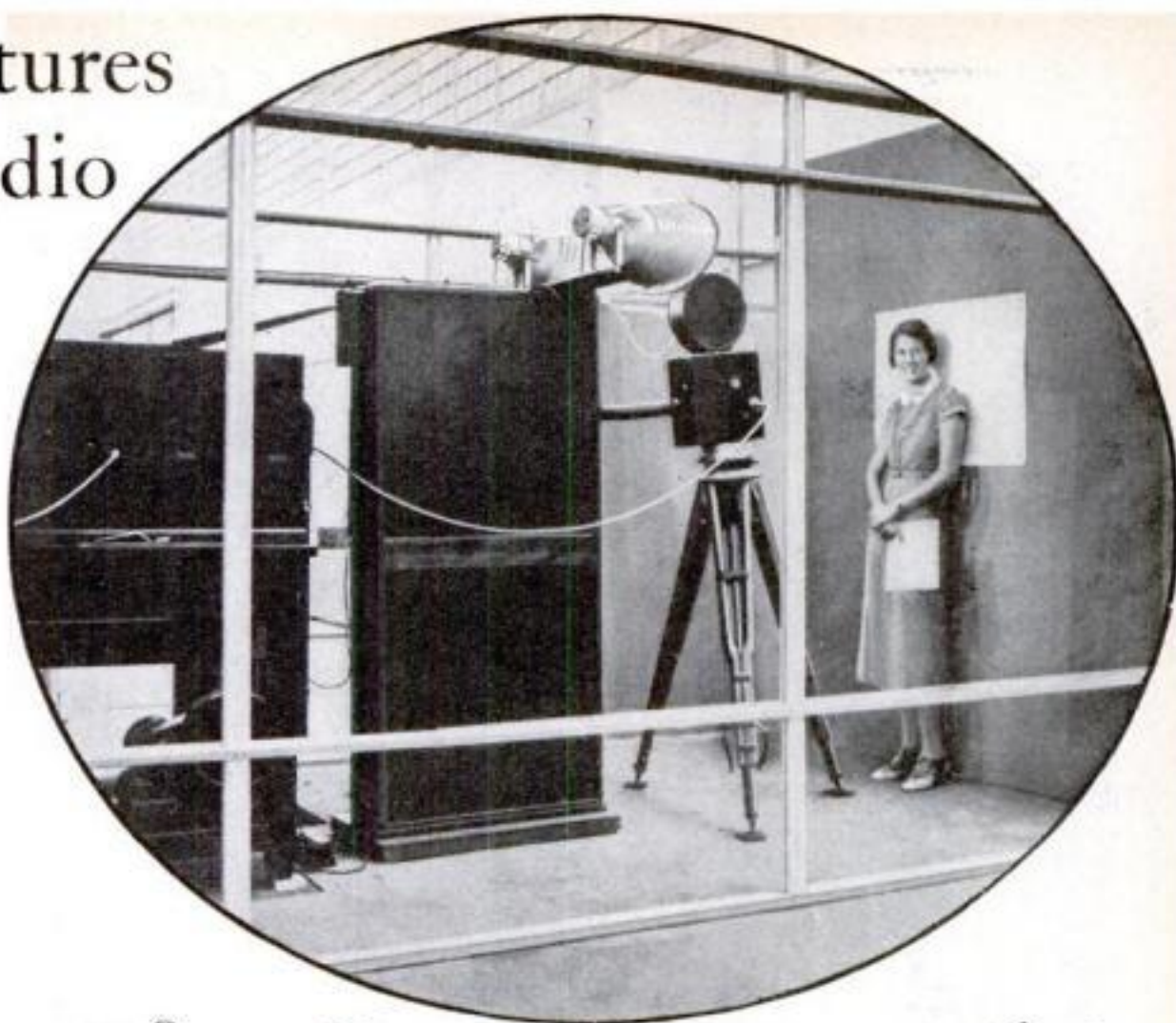
LEAD FED TO NEW PENCIL

cut away to show this interior mechanism. The pencil holds four feet of lead.

MERELY pressing down the cap of a new mechanical pencil, while grasping the lower part with the fingers, instantly provides the user with a fresh writing point. Each stroke of the cap operates an ingenious set of jaws that advance the lead the proper amount and then hold it firmly in place. A part of the pencil illustrated here has been

Movie-Film Pictures Broadcast by Radio

TRANSMITTING motion pictures by radio ten seconds after they have been made, is the achievement of a new form of television machine developed by German engineers. The results are described as superior to those of direct television, since it is easier to illuminate the film than the original subject with the high intensity required for radio transmission of the image. Exposed film from the camera whirs continuously through a light-proof tube of a developing chamber where it races through special chemicals that almost instantly develop and fix the image. While the film is still wet, it passes before a photo-electric cell. With the aid of a powerful lamp and a scanning disk, the image is dissected so that a transmitter connected with the cell can put it on the air. While the film is a "negative," showing black as white and vice versa, it is reversed in transmission by a simple electrical hook-up, so that the image finally appears in its correct values of light and shade. Experiments indicate the new style of "delayed television" is so adaptable to difficult lighting conditions that even night street scenes may be transmitted. In a further refinement of the process, its originators are seeking to perfect a way of stripping the used images from the film and re-sensitizing it so that it can be fed back to the camera and used over again in an endless cycle. This would not only reduce expense, but would also permit the use of extra-sensitive photographic emulsions that keep for only a short time. The present apparatus can be carried from one place to another on a small truck.



At top, a moving picture is being made and put on the air, the instant the film is developed. This new process of delayed television is fully explained in the illustration

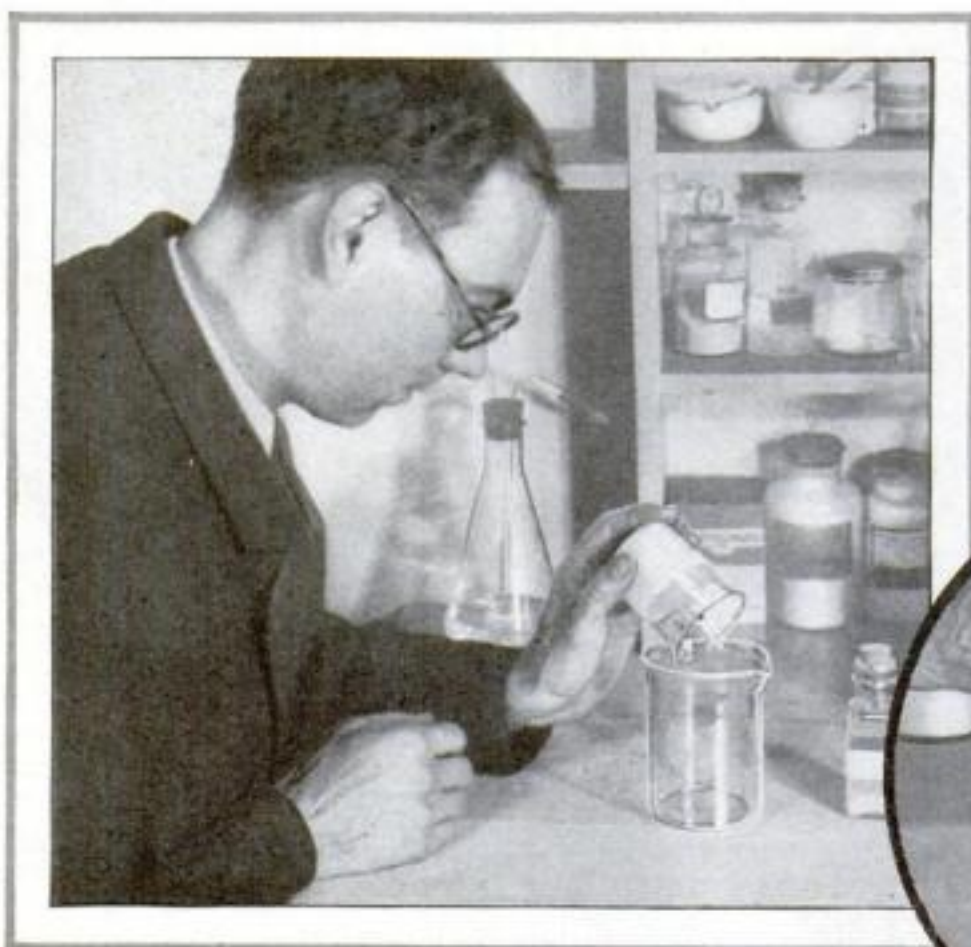
New Air Liner to Cut Transcontinental Flying Time



New streamlined plane, built for transcontinental service, has retractable landing wheels and twin motors capable of developing 1,400 horsepower. Its well-equipped cabin furnishes accommodation for twelve passengers

THE newest type of air liner for transcontinental service will be operated by Transcontinental & Western Air, Inc., on the fastest regular schedule in the world. This all-metal Douglas machine carries twelve passengers in its luxurious cabin, which with the rest of the liner, incorporates the most advanced design in streamlining. Retractable landing wheels fold into the wings when the craft is in flight. Twin motors, equipped with superchargers, develop a total of 1,400 horsepower to propel the big craft. During the next few months a large number of the new planes will be put in service. The photograph shows the one now ready to be placed in service.

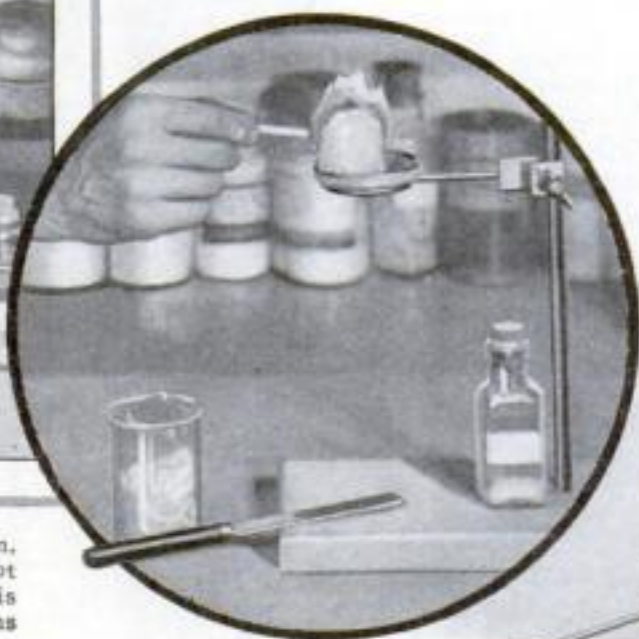
Home Tests *with* Calcium



After alcohol has been mixed with a calcium-acetate solution, a solidified alcohol results which, as is shown above, will not fall from the inverted beaker. When this jellylike substance is placed on a pan, as at right, and ignited with a match, it burns

... How to Make Mortar,
Luminous Paint, and Plaster of
Paris in Your Own Laboratory

BY
RAYMOND B.
WAILES



Automobile fender guides, like the one shown above, can be bent around pipes of different diameters, to make rings of various sizes which, when attached to an upright, will hold funnels, beakers, or flasks

WHAT makes mortar harden? Why does soap sometimes fail to lather? What is plaster of Paris and how is luminous paint made? These are only a few of the questions that are answered for you when you experiment with calcium.

Although calcium in its free metallic form is not common, its many compounds are known to us all. Marble is a combination of calcium and carbon, glass contains calcium combined with oxygen, and in the building trades we find calcium in cements and mortars. Even the bones in our bodies contain a form of this interesting and important chemical.

In the case of mortar, the compound of calcium is derived from lime (calcium oxide) made from a natural product called limestone. As an introduction to calcium, you can make some lime in your home laboratory by heating marble chips (calcium carbonate). Place the chips in a porcelain crucible supported over a gas burner. The heat will drive off the carbon-dioxide gas in the marble and lime, or calcium oxide, will be left behind. This is called quicklime.

By adding water to the lime, you can change it to calcium hydroxide, or slaked lime. This mildly basic substance is sometimes referred to as milk of lime while the clear calcium-hydroxide solution is known as lime water.

You also can prepare small amounts of lime by heating oyster shells or eggshells. In your experiments with lime you can

test its basidity by dipping red litmus paper into the water solution and noting if it turns blue.

When lime is mixed to a paste and sand is added, mortar results. The hardening of mortar is merely a reversal of the process used to produce it. In making the original lime, solid calcium carbonate is heated to drive off the carbon-dioxide gas. In setting, the carbon dioxide slowly returns to the lime (calcium oxide) and reconverts it into calcium carbonate.

This changing back to its original state, however, often requires many years.

Although mortar may be hard to the touch the day after it is laid, actually it requires some ten or twenty years completely to change to its solid state.

Plaster of Paris, another compound familiar to the building trade, also depends on the property of a calcium compound in setting. It is made by heating calcium sulphate, known in its natural state as gypsum, to a temper-

ature slightly higher than that of boiling water. This heating drives off the moisture. When the resulting powder is mixed with water, it hardens in a very short time, the water uniting with the calcium sulphate to form hard hydrated calcium sulphate.

If plaster of Paris is heated to a higher temperature, its time of setting can be lengthened. The home chemist can demonstrate this by comparing the setting time of ordinary plaster of Paris and



Mortar, made of lime, sand and cement, is used in building operations

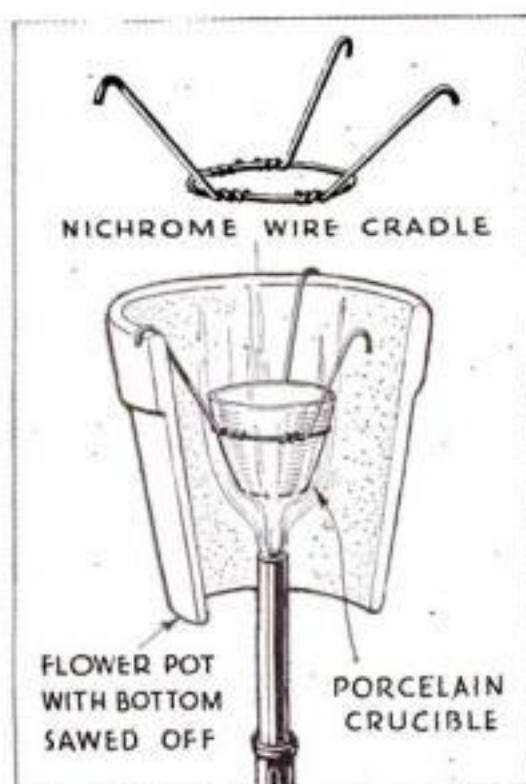
plaster of Paris heated to a high temperature over a gas burner in a crucible or the friction top of a tin can. Plaster of this type is said to be "dead burned."

BY COMBINING calcium with sulphur, the amateur chemist can make a mysterious luminous substance. After being exposed for a short period to a bright light, it will continue to glow when it is viewed in the dark.

The calcium for this experiment can be obtained from oyster shells. First heat the shells in a small porcelain or clay crucible over a burner and discard the darker portions of the cold residue. Then after powdering the lighter chunks, mix them with about twice their volume of flowers of sulphur, and place the mixture in a small porcelain crucible having a cover. Heat the crucible for about half an hour. As some of the sulphur burns, the experiment should be performed in a well-ventilated room or out of doors.

When the heated mass has cooled, expose it to the sunlight for a short time and then take it into a dark room. The mixture will give off a weird glow. If you fail to obtain the luminous effect, it will

Explain Industrial Processes



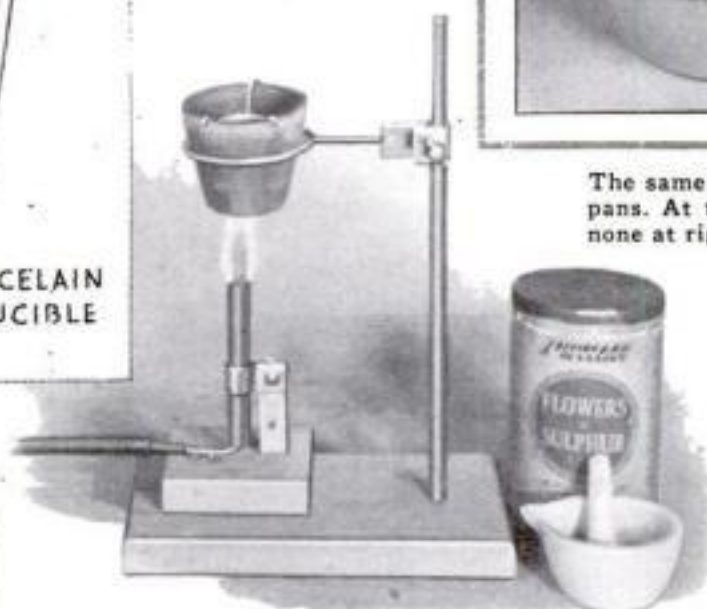
HOW TO MAKE HEAT RETAINER

At the top of drawing is shown the cradle made of nichrome wire so shaped that it hooks over the edge of a flowerpot. It then holds crucible above a flame and secures great heat

To make luminous dust out of calcium and flowers of sulphur, as much heat as possible is needed. The apparatus, made as shown at left, is used in this experiment which is demonstrated below. The flowerpot is used to prevent a too rapid loss of heat by radiation



The same amount of soap has been used in the water in each of these pans. At the left, a large amount of lather has been developed and none at right. Calcium chloride, added to water, right, made it hard



be because the compound was not heated sufficiently to combine the sulphur and calcium to form the calcium sulphide.

To obtain a high temperature with an ordinary burner and avoid radiation losses, you can arrange the flowerpot oven shown in the illustration. Cut the bottom from a small flowerpot with a hack saw, make a basket out of lengths of nichrome wire to support the crucible, and insert the crucible. The flowerpot can be supported on a convenient ring stand. If desired, the clay bowl of a bubble pipe can be used in place of a porcelain crucible.

Another luminous compound can be made by mixing 100 grams (less than eight tablespoons) of calcium carbonate, or precipitated chalk, two grams (about one half teaspoon) of chemically pure sodium carbonate, thirty grams (two tablespoons) of sulphur, and two tenths of a gram (pinch) each of salt and bismuth nitrate. Heating over a gas burner combines the calcium carbonate and sulphur to form calcium sulphide while the sodium carbonate and salt act as a flux and the bismuth nitrate serves as an exciter.

Plaster, used on walls, is another calcium product. It sets quickly but requires years to harden fully



In our experiments with carbon dioxide (P.S.M., Aug. '32, p. 60), we found that the gas could be made by adding muriatic acid to marble chips. After heating the acid and the marble, a thick, syrupy solution of

calcium chloride resulted. This same solution diluted with water can be used to illustrate the properties of hard water.

Hard water, as you have no doubt found, will not lather well unless a large quantity of soap is used. This is due to the fact that the water contains certain chemicals that combine with the soap to form a precipitate.

To show this experimentally, drop a piece of calcium chloride about the size of a pea or pour some of the calcium chloride solution into a pint of soft water. After the chemical has dissolved you will find it difficult to obtain a lather until a large amount of soap is used. For comparison, lather your soap in a pint of untreated water.

Examine the treated hard water carefully. You will note that a white precipitate is formed when the soap is added. As soon as the soap reacts with all of the calcium chloride in the water, however, suds will start to appear. It is the need for a large quantity of soap that makes hard water wasteful.

It is possible to treat hard water chemically to remove the hardening compound and make it soft. In cases where calcium chloride is the offending chemical in the water, sodium carbonate (soda ash, sal soda, or washing soda) can be added to precipitate the calcium carbonate.

Other compounds of calcium may cause water to be hard. For example, take some lime water and bubble carbon dioxide into it by blowing through a straw or glass tube. At first, a white precipitate of calcium carbonate will form. Continue to blow through the tube and eventually the precipitate will disappear as quickly as it

appeared. This is due to the fact that the carbon dioxide converts the calcium-carbonate precipitate, first formed, into calcium bicarbonate, a water-soluble chemical.

The solution that results is said to be temporarily hard. If it is heated, however, the bicarbonate breaks down to form calcium carbonate which is precipitated and the water is softened. Water that cannot be made soft by heating is called permanently hard.

Inspect the inside of your kitchen water kettle. If the sides and bottom are coated with a hard scale it shows that the water used is more or less hard. In boiling the water, the calcium carbonate precipitated forms a "fur" or brittle scale on the surface of the metal. This



Putty, with which window panes are held in place, contains a form of calcium carbonate

same action is present in steam boilers supplied with hard water. Being a poor conductor of heat, the calcium carbonate coating lowers the efficiency of the boiler. For this reason, industrial companies located where only hard water can be obtained often treat the water chemically before it is used in the boiler.

By making use of a curious property of calcium acetate, the home experimenter can prepare a novel form of solid alcohol similar to the jellied substance often referred to as "canned heat." The calcium acetate is made up as a saturated solution by adding the chemical to water until the solution will dissolve no more of the solid. One volume of this solution is added to nine parts of denatured alcohol.

Immediately, a grayish-white jellylike precipitate will be formed. Reaching an almost solid condition, it will remain in the mixing beaker even when the container is inverted. By cutting around the sides with a knife, loosen the mass and place it on the flat tin top of a can or bottle. Bring a lighted match near its upper surface and you will note that the jellied substance will burn with the colorless flame characteristic of alcohol.

Housekeeping Tools

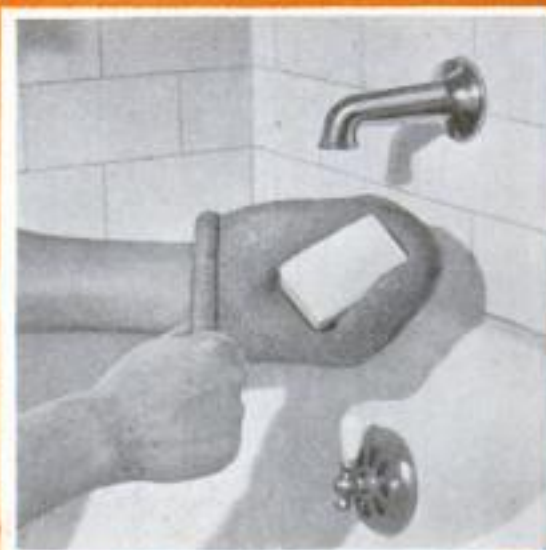
TO MINIMIZE LABOR



UP-TO-DATE COAL STOVE. Here is a modern coal range. It is so perfectly insulated that you can rest your hand any place on it but on the cooking plates. Coal is fed to it automatically and it burns only eight pounds a day. It has two ovens, one thermostatically controlled for baking, the other water-jacketed to keep the temperature under the boiling point. Hot water is available from a tap at the front. Draft is regulated by the lever at left. "Hot" and "medium" cooking plates are provided with this modern range

BATH MITTENS

The photograph at the right shows the latest kind of rubber sponge. It is in the form of a mitten and fits snugly on the hand when bathing. It is obtainable in various colors to match the bathroom



TO TIME EGGS

The new egg cooker at the left is of copper and resembles a double boiler. Cold water is poured in the top pot to a height indicated by three rings marked "hard," "medium," and "soft," depending on how you like your eggs. The eggs are placed in cold water in the lower pot and a medium flame is used. When eggs are boiled, the chicken whistles



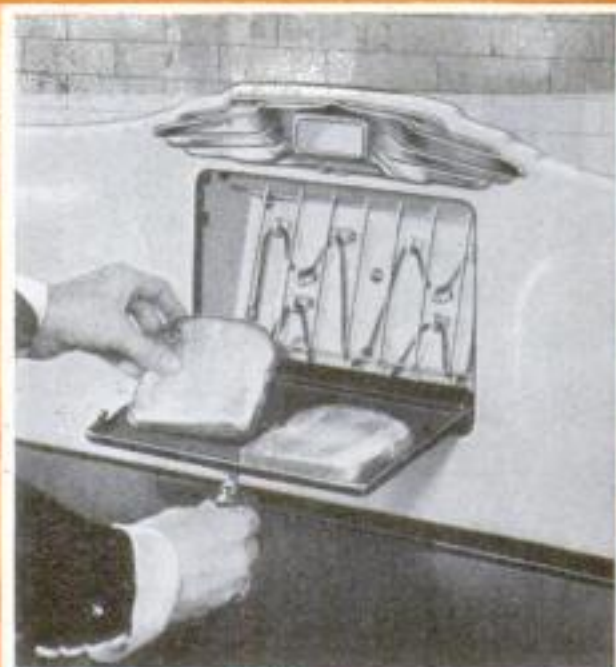
SINK-DRAINSTRAINER

The appliance shown above prevents refuse from washing down the sink drain. It also acts as a stopper when the handle is turned. It is easily lifted out so that the drain and its connecting pipes can be kept clear



PUMP BROOM

Where no electric current is available, the device at left makes a satisfactory substitute for a vacuum cleaner. Working the plunger up and down sucks the dust into the bag at the top. This is easily removed



TOASTER COMPARTMENT

A new gas range has a recess in the back in which a gas or electric toaster may be placed. When the toaster is not installed, the compartment may be used for storing small kitchen utensils



ELECTRIC FRYER. Smoke and unpleasant odors usually associated with deep-fat frying are eliminated, the maker claims, in this four-quart electric fryer for the modern home

MEDICINE SPOON. Giving medicine to children or invalids is facilitated by the extension which is placed in patient's mouth before the spoon is tilted



TYPEWRITER TABLE. A portable table for portable typewriters is adjustable to any height and can be used with any type of chair the operator fancies. It rests on metal legs and has filing compartment



SEALS THE TUBE. When attached to a tube of toothpaste or shaving cream, this cap automatically seals it and also provides a stand to hold it upright

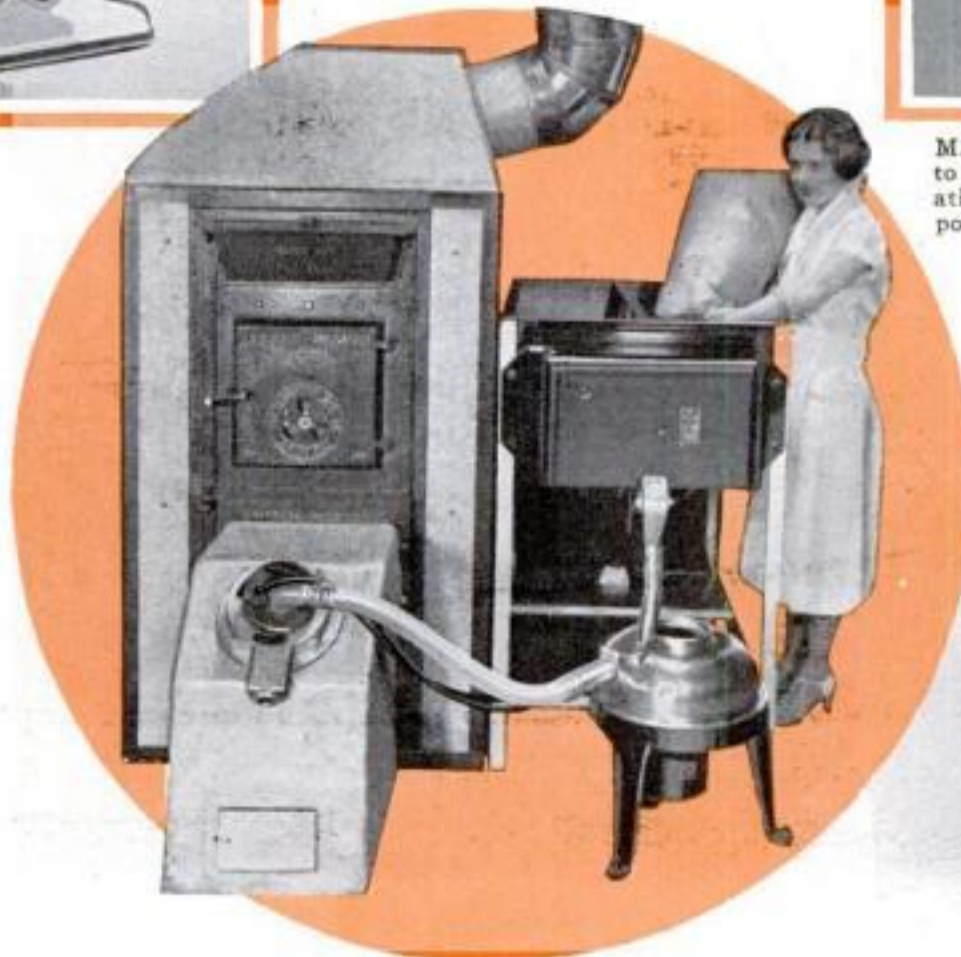


CORD REELS UP
Kinks in the electric cord, or tripping over excess cord, are impossible with the vacuum cleaner above because the cord is wound on an automatic reel that frees whatever length of cord is needed, then winds it back into the handle at the touch of a convenient button

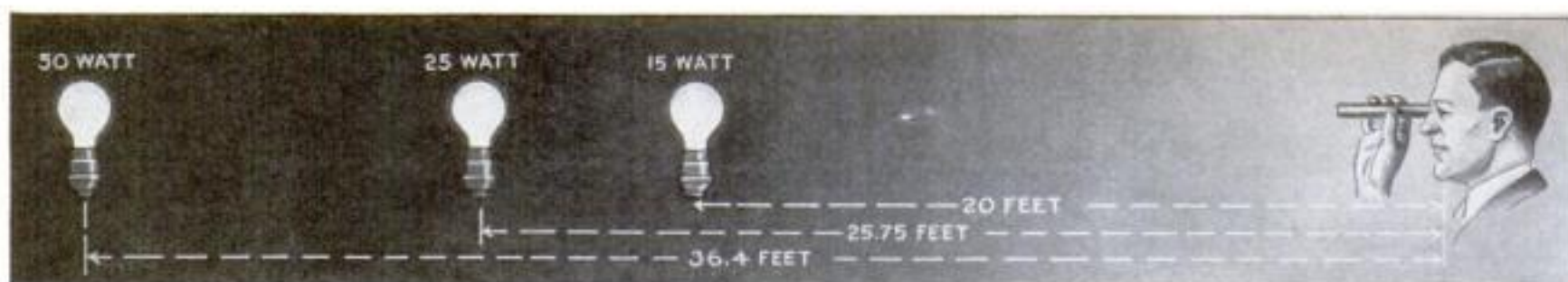


MAKES RUGS NON-SKID. When applied to the under side of a rug, this liquid preparation will prevent it from slipping even on a polished floor. It is said not to harm the rug

GRINDS OWN COAL
Pulverized coal can be burned in the home furnace with the outfit at the right. It consists of a 500-pound hopper, an electric grinding mill, and a burner. Half-inch screenings are hammered to powder, piped to the furnace on an air stream and ignited by an electric spark. They burn like gas



SAVES TOOTHPASTE
This frame holds the toothbrush and also insures no waste of toothpaste, by the action of a ball device which squeezes the paste out uniformly until it is all used

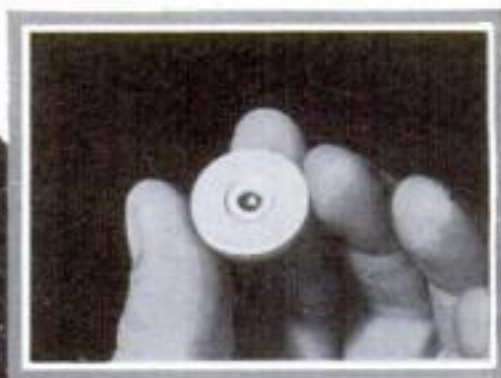
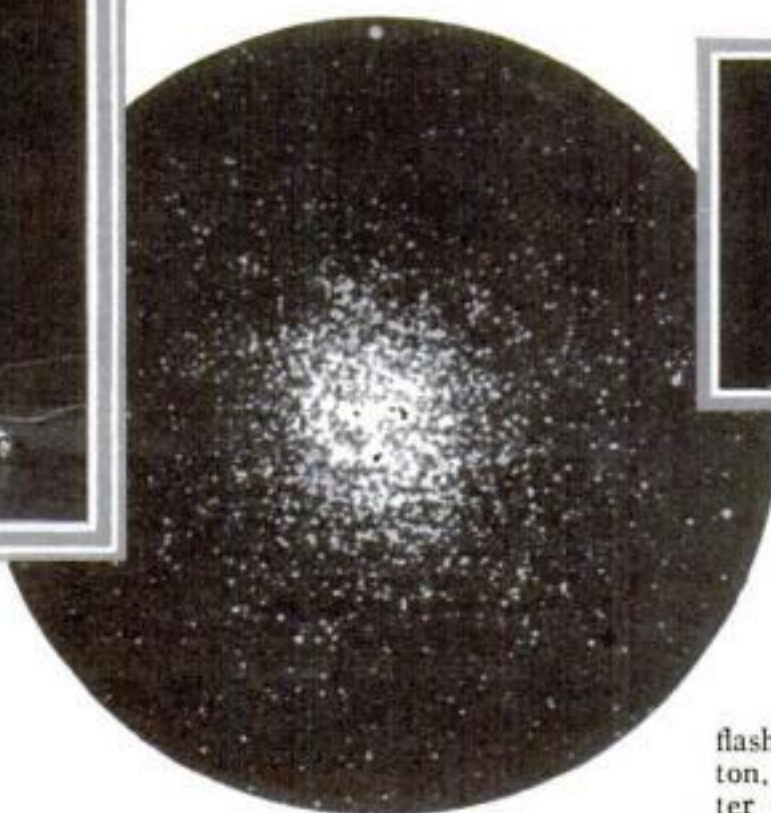


How Stars Are Measured



A flasher button is used to find the number of times light bulbs of various sizes will flash per minute. When this is known, their relative strength can be judged readily at any distance

Experiments with Three Light Bulbs and a Flasher Button Show Method Used to Find Distance of Winking Suns from Our Earth



Above, flasher button is operated by the heat of the bulb to which it is attached. At left, star cluster, 20,000 light years away. The length of the stars' winking periods gives the key to their actual distance from our earth

NEARLY everyone instinctively thinks of the brightest fixed stars in the sky as the nearest, and the faintest as the farthest away. Yet the nearest star to our solar system, Proxima Centauri, needs a telescope to see it, while Sirius, the brightest, is twice as many light years away.

A simple experiment with three electric bulbs, representing stars, will illustrate the fact that apparent brightness is no true measure of distance.

If bulbs of fifteen, twenty-five and fifty watts are set up on three standing lamps in a long, dark hall or corridor, they can be arranged at intervals so that the bulbs will all appear to be of the same brilliance.

If the fifteen-watt bulb is twenty feet from the eye, the twenty-five-watt bulb will need to be twenty-five and three quarters feet away, and the fifty-watt thirty-six and two fifths feet distant.

If the lamps were arranged at these intervals in your absence and you were called in to look at each through a paper tube and pick out their relative brilliance, you could not do it.

But after performing a little experiment with a common flasher button, such as is used to make Christmas-tree lamps and store-window signs flash on and off regularly, you could tell which bulb was brightest.

Place a slow flasher button in any lamp socket and then screw in your three bulbs one after the other, timing the number of flashes that each lamp makes in a minute. In repeated tests made by the writer, he found that the fifteen-watt bulb averaged twenty-one flashes, the twenty-five-watt eighteen flashes, and the fifty-watt sixteen flashes per minute. The varying speeds are due to the different amount of heat developed by the various lamps.

If each of the three lamps in the dark hall is then screwed in over a slow flasher button, you would no longer be deceived about their brilliance, no matter how near or how far away the lamps were placed. By counting the number of flashes per minute by your watch, you could unerringly determine the strength of each bulb, no matter how bright or dim each appeared to be.

This little trick illustrates beautifully the way in which astronomers recently have calculated the actual brightness of a certain class of stars known as Cepheid variables.

These stars are suns that have reached a point in their lives where they pulsate regularly from bright to dim and back again. Just as the stronger electric bulb

flashes slower on the flasher button, so an actually brighter, hotter star goes through its cycles from bright to dim and back again more slowly than a less hot star.

Accordingly the astronomers have classified the brightness of these remarkable stars as those that require five, ten or twelve days to wink, just as we classified and identified our electric bulbs by the number of flashes per minute.

In the same way, after the period of a variable star is carefully observed, its actual brightness is known. It only remains then to determine, with accurate light-measuring instruments, how much less bright it appears to be, in order to figure out how far away it actually is.

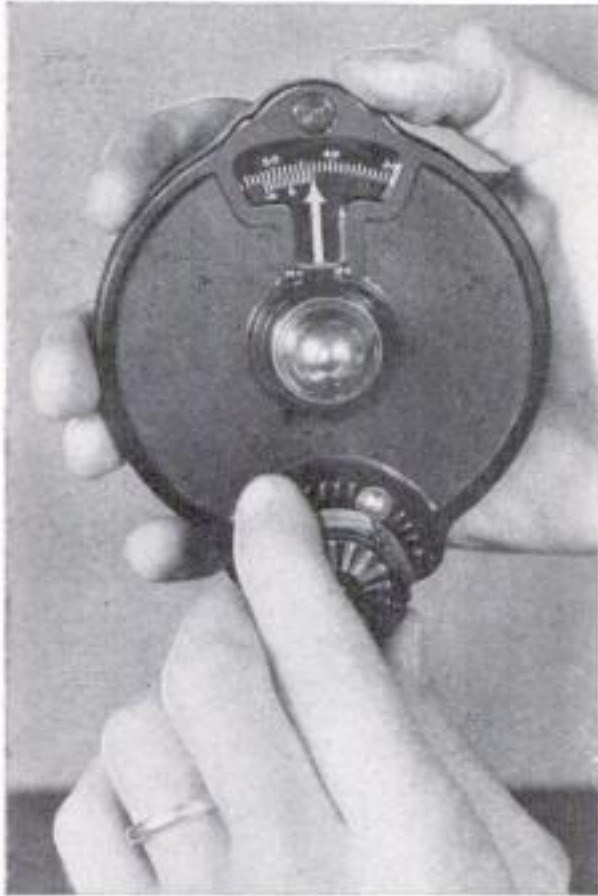
A parallel example, taken from our three light bulbs, will make this process clear.

If our fifty-watt bulb is placed 100 feet away, it will be only one-fourth as bright as at fifty feet, in accordance with the law that brightness varies inversely with square of the light's distance from the observer. One hundred feet is twice as far as fifty feet. The square of two is four, and the inverse of four is one fourth.

By discovering that the bright-dim period of the variables represents their actual degree of heat and brightness, astronomers have now gained a far more accurate yardstick for measuring the universe than they have ever possessed before.

New Stations Easily Found

LOCAL TESTS GIVE DIAL READINGS THAT
WILL HELP DX FANS MAKE ACCURATE LOG



Finely graduated dial that assists listeners in accurately logging all their distant stations

RECEIVER dials marked with arbitrary scales that bear no relation to meters or kilocycles often cause the amateur trouble when he attempts to find a new station. However, by employing a simple trick of proportion, he can read his "0 to 100" scale with greater accuracy than one marked in wave lengths or frequencies.

Every local station carefully logged increases the ease with which new stations can be found. After a number of stations have been spotted, it is an easy matter to adjust the dial to a calculated point and wait for the distant station to fade in.

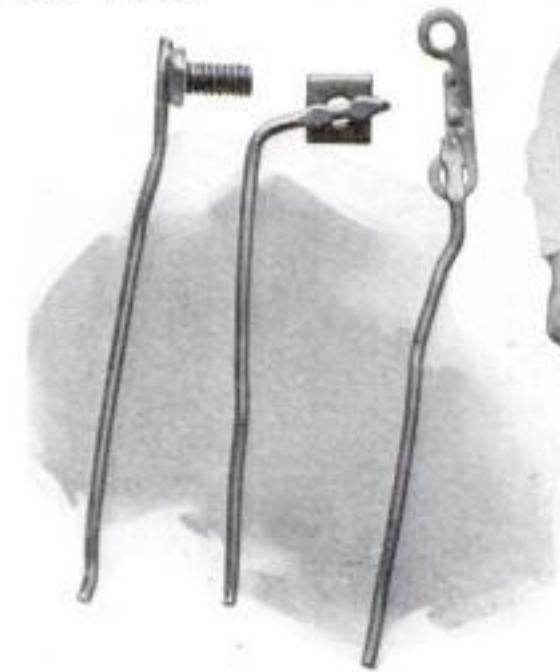
For instance, suppose in local tests a 600-kilocycle station is located at eighty-three on the dial and a 660-kilocycle station comes in at seventy-three. Stations on the 630-kilocycle band then will be found halfway between the two at seventy-eight. Using a similar proportion, other unknown stations around the same frequency can be accurately located.

Of course, the error in the unknown setting will be greater when the two known stations are spread far apart on the dial. For this reason, it is best to locate as many locals as possible and use the dial readings for adjacent stations for the calculation.

To assist amateurs who take pride in the accuracy of their DX logging, a micro-vernier dial is available. Resembling the vernier reading scale on a micrometer, a stationary set of ten divisions running from the left of the pointer makes it pos-

sible to log stations accurately to one tenth of a degree. It is necessary only to decide which mark on the vernier scale matches up with a division on the dial to obtain the fractional degrees.

This dial also is equipped with a unique type of drive that can be adjusted to any speed within a certain range. Turning a small lever, concentric with the main dial knob, adjusts a variable friction drive that varies the turning speed of the main dial.—W. H.



Small parts can be held in place for mounting in the depth of a radio set by using a short piece of soldering wire as is shown above and at left

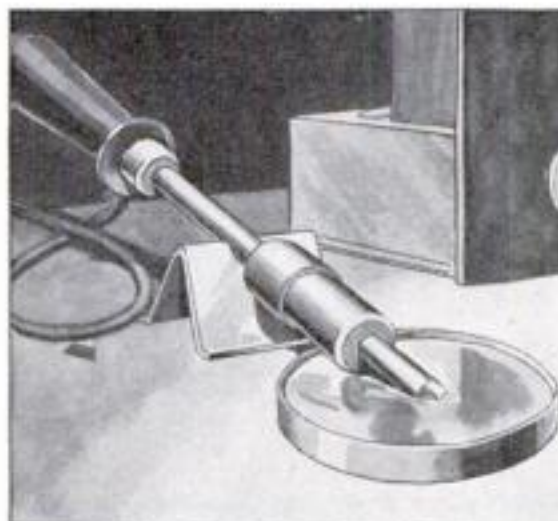
Solder Wire Puts Small Parts in Place

WHEN you find it difficult to place a nut, a bolt, or some other small part in the depths of the radio you are building or repairing, you can turn to your roll of solder wire for a solution.

For instance, if you want to start a nut on the threads of a bolt located in an out-of-the-way corner, you may find that your fingers are too fat or too short. Simply clip a convenient length of wire from your solder roll, lay one end of it across

the top face of the nut, and tap it with a hammer. The soft, pliant solder will be molded around the nut and hold it tightly. In the case of a machine screw, the solder wire is imbedded in the slot.

If the part is to be placed under a transformer or some other projection, the solder wire can be bent into any shape or curve to reach around the corners. When the job is completed, a quick jerk will free the wire.—E. P. B.



Melted resin placed in shallow pan can be used to keep the point of soldering iron bright

Melted Resin Keeps Your Soldering Iron Clean

NEXT to patience, cleanliness is the secret of neatly soldered joints. For this reason, a shallow pan bent from sheet tin and filled with resin will form a valuable addition to your soldering kit. By resting the tip of your hot iron on the resin during a soldering job, you can keep it clean and bright and free of any troublesome oxides. Simply melt the resin over a gas flame, pour it in the pan (the friction top of a tin can will serve), and allow it to harden. In use, place the resin pad in front of your iron rest and tip the iron so the point rests in the resin.—D. B.

With this combination five-meter receiver and transmitter, only a three-foot brass tube is the antenna

Ultra-Short- OPENS NEW FIELD



By
John Carr

STEEL workers cling to the bare skeleton of a new bridge. In each group, a man, earphones on his head and microphone in his hand, adjusts controls on a small metal box.

Hundreds of yards separate the engineers from the riveting gangs. Half the span stretches between the cablemen and their ground crews. Yet orders are given and received with the certainty and ease of the telephone.

Such is the part ultra-short-wave radio soon will play in the construction of bridges. Already tests have been made and circuits devised for portable five-meter radio telephone sets that can be carried into the field on any kind of construction job.

But engineers and steel companies are not the only ones who have found uses for the ultra-short waves. New fields have been opened for the experimenter. Licensed amateurs are now turning to the shorter five-meter band for new thrills and possibilities.

The ultra-short waves are just what the name implies. Until recently, they were considered useless. Radio consisted mainly of two general divisions, the broadcast band ranging from 550 to 1,500 kilocycles and the regular short waves

extending from 1,715 to 14,000 kilocycles. During the past few years, however, the five-meter band has gained in popularity, forming the basis of a new group of waves of greater frequencies.

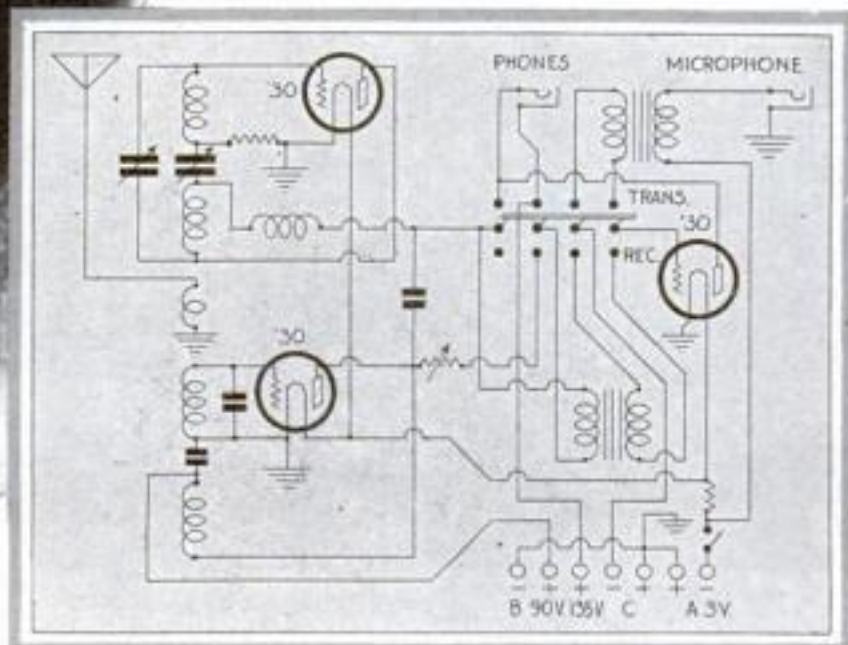
Unlike the longer broadcast waves, five-meter signals do not follow the curvature of the earth but like light, travel along the line of sight. For this reason, the range of a 56,000 kilocycle outfit is often referred to as the line-of-sight range. Up to the present, few long distance transmissions have been made.

However, it is in short-distance

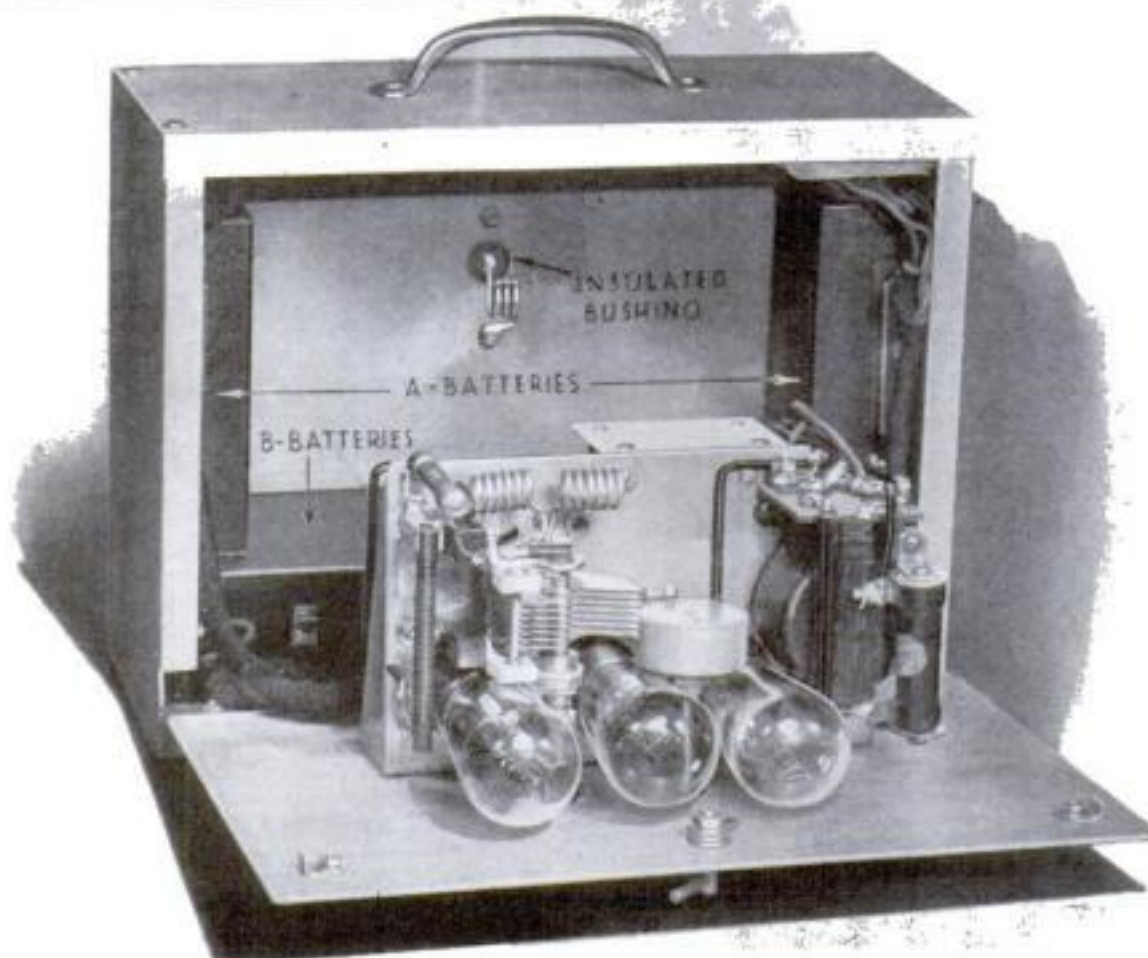
work that the five-meter band comes to the fore. It has few of the handicaps of the longer waves—static is less noticeable, fading a rarity, and light battery equipment practical since little power is required. For the amateur, a five-meter phone is ideal for short-distance messages.

Unfortunately, the make-up of a regular short-wave receiver will not allow it to break in on the ultra-short waves. For the higher frequencies, a super-regenerative circuit must be used. Such a circuit is shown on the opposite page. By studying it, you can gain some idea of the arrangement.

Designed especially for the experimenter, the circuit consists of three tubes ('27s) rigged as a detector, an oscillator, and an amplifier, and an antenna that allows the set to be used over a wide range of frequencies. Tuning is accomplished by shortening or lengthening a miniature antenna rigged in the



At left, diagram for the five-meter transceiver. Three type '30 tubes are used in the circuit. Below, view showing the compactness of the chassis. The antenna coupling coil can be seen mounted on the rear of the cabinet. This is connected from antenna to metal cabinet



Wave Radio

TO AMATEURS

shape of a V. By means of a knob and a spring to take up the slack, the two legs of the antenna can be twisted or untwisted to vary the effective length of the wires. The longer the two legs of the V, the longer will be the wave length received.

In arranging the antenna, connect the apex of the V through a coiled metal spring to the control knob and the two outspread ends to two binding posts placed about eight or nine inches apart. The wires in their untwisted position should stretch out at least two feet.

As can be seen from the diagram, the apex of the V-shaped antenna is connected to the interrupting oscillator coupling coil. The two inner ends lead to the plate and grid circuits of the detector tube.

In winding the inductance coils, for the interrupting oscillator, they should be arranged so that the coupling can be varied. Two coils that can be moved closer together or farther apart will serve in an experimental outfit.

To operate the receiver, the 100,000 ohm resistance (A) and the variable condenser (B) are first adjusted to bring the set into oscillation. Actual tuning is accomplished by adjusting the antenna length and the variable condenser (C) in the antenna circuit.

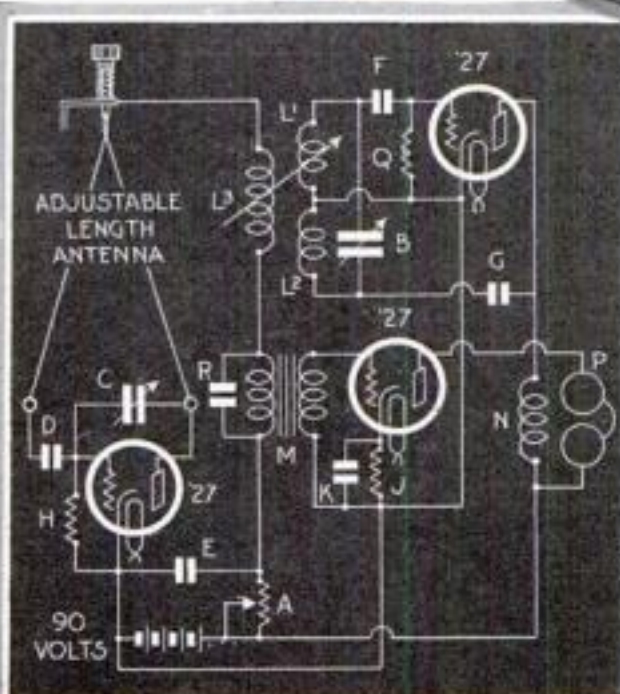
For portable work in the five-meter region, amateurs generally resort to a three-tube receiver and two-tube transmitter. Where maximum compactness is required, a combination receiver and transmitter circuit is used.

A trans-ceiver, as these five-meter portables are sometimes called, is shown in the photographs. Weighing little more than an ordinary typewriter case, this phone station uses a three-foot length of brass tubing as an antenna. It can be seen projecting up from the rear of the cabinet. In tests, its power supply of three forty-five-volt B batteries has allowed clear telephone communication for line-of-sight distances up to one mile.



To listen in on the ten-meter band, tap the upper unit on your twenty-meter coil at the second or third turn and short out the rest

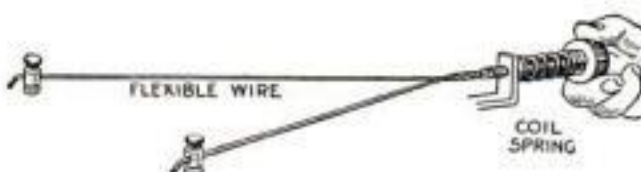
Front view of the trans-ceiver cabinet showing the panel arrangement. The switch at the extreme right changes circuit from one for receiving to a phone transmitter



LIST OF PARTS

- A—Potentiometer, 100,000 ohms.
- B—Variable condenser, .0005 mfd.
- C—Miniature variable condenser, .00005 mfd.
- D—Fixed condenser, .0001 mfd.
- E—R. F. By-pass condenser.
- F—Fixed condenser, .0005 mfd.
- G—Fixed condenser, .006 mfd.
- H—Grid leak, 1-2 meg.
- J—Resistance, 1,500 ohms.
- K—Fixed condenser, 1 mfd.
- L₁, L₂, and L₃—300 turns of No. 30 d.c.c. wire on 2 in. core random wound to 2 in.
- M—Audio transformer.
- N—Choke, 60 mh.
- P—Earphones.
- Q—Resistance, 25,000 ohms.
- R—Interrupting frequency by-pass condenser, .0005 to .002 mfd.

With a few odd parts, as listed above, you can make an experimental ultra-short-wave receiver that will cover a wide band of frequencies. This circuit operates on the adjustable length antenna that is shown in the illustration below



One set of parts serves for both receiver and transmitter. A flick of a switch located on the front panel quickly changes the circuit from one for receiving to one for transmitting. It is combination sets of this general type that will find their way into construction work and police activities in unrestricted areas.

As a receiver, the circuit is a three-tube super-regenerative. With the switch in the receiver position, these tubes become the detector, the low-frequency oscillator, and the amplifier. When transmitting, the detector becomes the power oscillator, the second tube is eliminated, and the audio amplifier serves as the modulator. With three tubes, a three-tube receiver and a two-tube transmitter are obtained.

On the front panel of its metal cabinet are four controls. A variable resistance, a knob for the tuning condenser, a filament switch, and the change-over switch for converting the outfit into either transmitter or receiver. The microphone and the earphones are plugged into jacks located directly below the tuning condenser.

At the rear of the cabinet, a heavy-duty binding post supports the three-foot length of brass tubing that serves as the antenna. Inside the cabinet, directly behind the antenna terminal and connected to it through an insulated bushing, is the antenna coupling coil. As shown in the photograph of the opened set, the antenna coil is so placed that the other inductances swing up in a direct line with it when the front of the cabinet is closed.

In use, the operator carrying the outfit places the earphones on his head and carries the microphone in his hand. By merely operating the changeover switch, he then can carry on a two-way conversation with any other nearby trans-ceiver.

The ten-meter band also opens an interesting field for the amateur experimenter. (Continued on page 102)

Quick Starts

ON COLD MORNINGS

OUTSIDE the house, wintry winds howled, but in spite of that, beads of perspiration stood on Dan Nolan's forehead as he reached for the telephone.

"Give me Center 650," he bellowed after jiggling the hook impatiently.

"Hello, Model Garage? That you, Gus? Well this is Nolan up on Pine Road. I can't get my car started. What's that? Yeah, I've tried everything. It must be frozen or something."

Less than twenty minutes later, Gus Wilson was standing in front of Nolan's small one-car garage.

"Blamed if I know what ails it," said Nolan as he opened the garage door and kicked a hand crank lying on the cement floor. "Can't even get a rise out of her with that. Wound her up till I was all in, without so much as a sputter."

Gus climbed into the car and leaned over the wheel. "Let's see what luck I have," he said as he pulled out the choke button and stepped on the starter.

The motor groaned but failed to start. "Your luck's no better than mine," Nolan observed. "I tell you she's cold. Isn't there some way we can warm her up?"

Gus lifted the hood and poked at the motor with his stubby fingers.

"Let's give her another try by hand," the veteran mechanic said finally. "You pull out the choke button and hold down the clutch pedal while I man the crank."

"What's the idea of holding down the clutch?" put in Nolan as he took his place in the driver's seat.

"Makes it easier cranking," Gus explained. "You don't have to push the neutral gears through the cold grease in the transmission."

WITH Gus's brawny arm bearing on the crank, the motor seemed to turn easily. With almost the first twist, the engine coughed and sneezed and finally spun under its own power.

"Well I'll be hanged!" gasped Nolan. "What did you do, hypnotize it?"

Gus chuckled as he ambled around to the side of the motor.

"Come out here a minute," he said, smiling, "and I'll show you something. The main thing that was ailing this motor was a loose set screw."

"A loose set screw?" Nolan repeated.

"Sure. Do you see that connection where the choke wire fastens to that arm on the carburetor? When I opened the hood, the set screw was gone and the

wire was hanging loose. Naturally the choke didn't work. All I had to do was pick the set screw out of the pan and put it back into place."

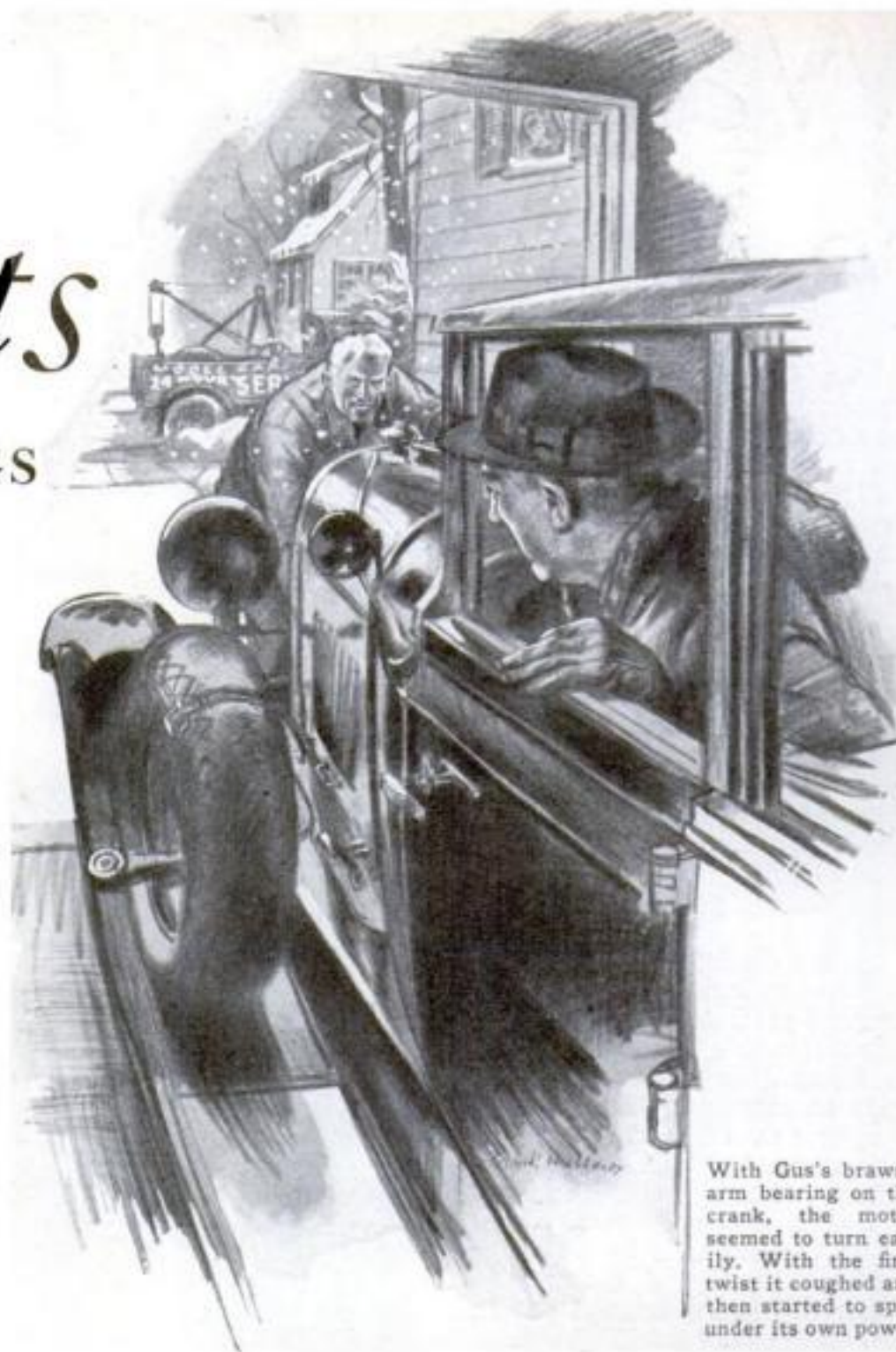
"But the cold weather had something to do with it, didn't it?"

"Oh, it probably made the motor a little stiff," agreed Gus. "But cold or no cold, that car would have started if the choke had been working."

"Gosh, simple as that, eh?" Nolan sighed. "In the winter I'm always looking for trouble. I wish I could put some sort of a gadget on the car that would make it start easier on cold mornings."

"If that's all that's bothering you, there are plenty of trick attachments," said Gus. "The latest one I've seen is a midget electric heater that fits right in the cooling system. It looks like one of those aquarium heaters. All you have to do is plug the connection cord that comes with it into the garage lighting circuit."

BUT extra appliances and knowing how to start a cold motor aren't the only things that make winter driving easier. It's little troubles like that loose choke rod that cause the headaches. If a



With Gus's brawny arm bearing on the crank, the motor seemed to turn easily. With the first twist it coughed and then started to spin under its own power

By

MARTIN BUNN

car's conditioned for cold weather, you'll—"

"Yeah, I know," put in Nolan with a grin. "You're going to tell me I ought to dope my radiator with anti-freeze."

"That just keeps your motor from freezing," said Gus, "but it won't make cold-weather starting any easier. Fuel, spark, and oil are the important things in getting a motor started."

IN THE first place, don't fool around with cheap grades of gas. You may be able to get away with it in hot weather but they'll cause plenty of trouble in the winter.

"It's the same way with spark plugs. Treat yourself to a new set every winter. A weak spark never started a cold motor. You ought to change them every ten thousand miles anyway. For the average driver that means at least twice a year, winter and summer."

"Give your ignition wires the once over. Run your motor in the dark and watch for those dancing blue sparks that mean leaks and wasted power. From the looks of yours, I'd say you need a whole new set."

"Then, there's the oil. When it's cold, heavy summer oil gets like so much molasses. Change *(Continued on page 99)*



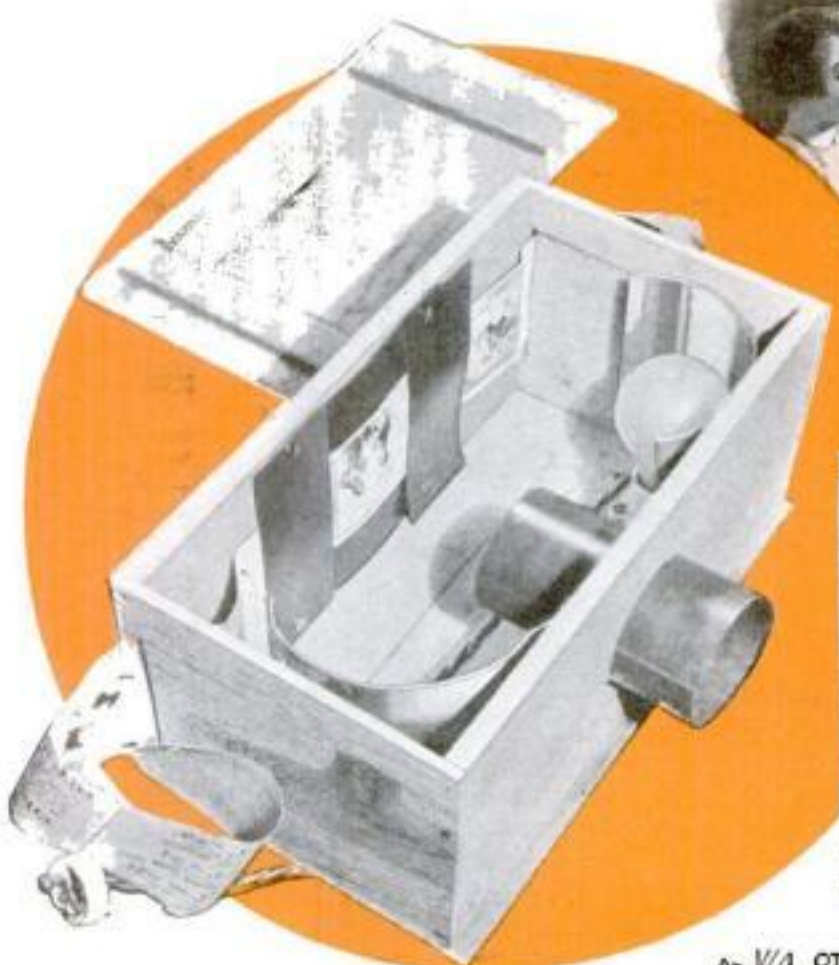
THE HOME WORKSHOP

MODEL MAKING : HOME WORKSHOP CHEMISTRY : THE SHIPSHAPE HOME

Comic-Strip "Talkies"

GIVE CHILDREN ENDLESS FUN AT HOME

By Morton Bartlett



The magic lantern is built of odd and ends, and has a magnifying or reading glass as a lens. Two 100-watt lamps provide the light.

UNIQUE comic-strip "talkies" can be given in your own home at trifling cost. The pictures are thrown upon a screen by means of a simply made magic lantern, and the children speak the lines of the various characters through a home microphone connected to an ordinary radio receiving set.

The materials are listed on page 85. The first step is to make the lantern. Its width is equal to the focal length of the magnifying glass which will be the lens. Determine this by tacking a piece of paper against the wall 10 ft. from a lighted lamp. Hold a ruler perpendicular to the paper, and run the lens, perpendicular to the ruler, along the inch marks. At



Speaking into a home microphone, the children take the parts of the comic characters

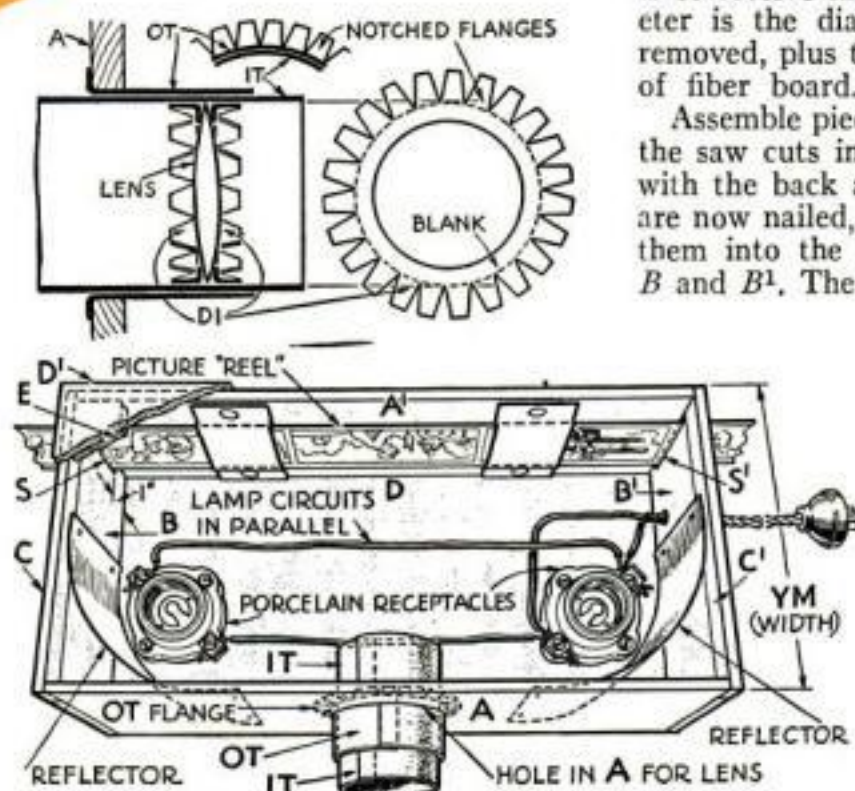


some point a clear image of the lamp will be seen on the paper. The focal length may now be read from the ruler. This distance is the dimension YM in the drawings. Having found this basic dimension, cut ten pieces of wood as specified in the list.

Cut a round hole in the center of piece A to receive the lens assembly. Its diameter is the diameter of the lens, frame removed, plus the thickness of five pieces of fiber board.

Assemble pieces D, A, A^1, B, B^1 . Make the saw cuts indicated by S and S^1 flush with the back and 5 in. long. C and C^1 are now nailed, and nails are run through them into the two unsecured corners of B and B^1 . The top is left separate to allow access to the interior. Ventilation need not be considered as plenty of air will circulate through the cracks.

The reflectors are tin cans. Remove tops and bottoms, split up the sides, and spread open enough to fit them into the front corners of the lantern. Polish them (Continued on page 85)



Announcing A GREAT



*A
nonprofit
organization
founded to help
you develop
your handicraft
hobbies and
make the most of
your increased
leisure under
the NRA*



...The National

AT LAST the home craftsmen of the United States are to have their own national organization. It is to be a great mutual benefit association for those who follow any type of handicraft hobby. It will pay huge dividends—not in cash, but in good fellowship, in opportunities for learning better craftwork methods from experts, in the development of club and community projects, in the interchange of ideas, in actual savings through discounts on the purchase of materials, supplies, and plans, in giving access to special tools, machines, and equipment, in the stimulation that comes from having an official magazine and annual exhibitions, and in all the things that will make your own home workshop, no matter what you use it for, more pleasurable, more useful, and more profitable. In short, it is the best solution yet offered for the intelligent and enjoyable use of the increased leisure insured to everyone by the NRA.

The new association is the National Homeworkshop Guild, Inc., with headquarters in Rockford, Ill. It has been chartered in the State of Illinois as a noncommercial organization. LeVern T. Ryder of Rockford, is the president, and E. Raymond DeLong, also of Rockford,

the secretary. With one exception, the members of the board of directors are also residents of that city. In addition to these officers, the Guild has an advisory council of most distinguished men, each one of whom is a national leader in his own field. Its official magazine will be *POPULAR SCIENCE MONTHLY*.

"How can I join the Guild?" is probably the question you are already asking. This information, the necessary application blanks, and many facts that cannot be compressed into this article will be sent you from the national headquarters in Rockford if you will address a request to the Home Workshop Editor. Use the coupon at the end of this article and please inclose a large self-addressed, stamped envelope. The Guild has printed a reasonably large quantity of bulletins explaining how to start a local club, but there is no telling how quickly the supply will be exhausted, so don't delay.

It may have struck you as curious that this splendid movement should have originated in Rockford. There is a very good reason for it. Rockford already has the largest and most successful home workshop club in the world. In October, 1932, invitations were sent to forty men known to have an interest in handicraft asking them to attend an organization meeting.

Forty-seven came. Mr. Ryder explained that a club was to be formed to exchange ideas, conduct helpful programs and demonstrations, and to foster a wider interest among the people of Rockford in the useful employment of spare time.

The success of the club exceeded all expectations. It grew with amazing rapidity and now numbers more than 100 members from every walk of life. Outgrowing its original quarters, it became affiliated with the Rockford Art Association and obtained the use of a large hall in an office building.

Its activities have been exceedingly diverse and in all cases useful. At its bi-weekly meetings, members criticize and make suggestions for improving one another's completed projects; demonstrations of correct procedure in the use of hand and machine tools are given by members and professional craftsmen; members exchange tools; and those with exceptionally well-equipped shops frequently place their equipment at the disposal of other members.

Last Christmas the members of the club made several hundred toys for a local children's home. In February the club gave a handicraft exhibition, and more than that 5,000 visitors attended. Several unemployed members of the club have

NEW CRAFTSMAN'S CLUB •

obtained jobs in local manufacturing plants because of exceptional technical skill demonstrated at the club meetings.

Among the members are lawyers, doctors, merchants, foundrymen, machinists, toolmakers, accountant, photographers, carpenters, ministers, reporters, and painters. The output has covered practically everything that a home workshop can produce—furniture, models of ships, engines, and houses, jewelry, bows and arrows, bird houses, aquariums, speed boats, rowboats, fishing rods, pewter ware, hammered copper, brass, and iron, hand-forged hunting knives, and wood carving. By working out production methods, the club found it a simple matter to make more than 100 doll cradles, hobbyhorses, baseball bats, vanity cases, and puzzle boards for the orphanage.

More ambitious still was their annual club project. They decided to make a drill press in which would be incorporated all the best ideas of the members, including improvements not to be found in any commercial drill press. The ideas were criticized and worked over by several mechanical engineers who belong to the club. Patterns were then made under the supervision of a patternmaker; the cast-

ings were prepared with the expert advice of several foundrymen; then the machinist members of the club divided the remainder of the work among them.

Every meeting of the club offers something tangible to the members. At one meeting an expert from a tool company may demonstrate how to care for and sharpen tools. At another meeting one of the more advanced members may give instructions in wood carving. Decorative metal work, patternmaking, the pouring of metal castings in the home workshop, furniture construction, the use of wood-working machinery, operating an engine lathe, and similar topics are taken up. Each meeting is followed by helpful discussions. The librarian of the club is always in attendance and has available books, magazines, plans, and a complete set of catalogs of tools, machines, equipment, and supplies. And in all this there has been nothing in the least commercial—no effort to sell members merchandise or to influence them to buy certain brands. Prices are never mentioned at club meetings. Every club member, however, can obtain a discount for everything he buys for his home workshop merely by showing his membership card to the mer-

chants in Rockford. Strange to say, this was nothing the club requested; it was a voluntary arrangement suggested by the merchants themselves to show their appreciation of the advantages of the club and their desire to cooperate with it.

Why should there not be such a club in every community in the United States? It is to make this possible that the new National Homeworkshop Guild has been formed. All the preliminary planning has been done, so that you can organize a local club with very little difficulty. Talk it over with your friends. If you do not know any others who are interested in the home workshop hobby, speak to your hardware dealer, lumber merchant, and paint dealer. They will be only too glad to tell you who are regularly buying materials for craftwork. Interest the newspaper editors and the local manual training teachers in the idea; they will give you names of probable members and help with publicity and advice.

All you need to join the National Guild is to organize a club of not less than five members. Each member of such an affiliated group will hold an individual card in the National Homeworkshop Guild. The Guild will also [\(Continued on page 89\)](#)

Homeworkshop Guild

THE DISTINGUISHED MEMBERSHIP OF

THE ADVISORY COUNCIL

Professor Collins P. Bliss

Dean of the College of Engineering, New York University

Dr. Clyde A. Bowman

Dean of the School of Industrial Education, Stout Institute, Menomonie, Wisc.

Harvey Wiley Corbett

Architect, Chairman of the Chicago Century of Progress Exposition Architectural Commission, and one of the designers of Radio City in New York

Dr. Hugh S. Cumming

Surgeon-General, U. S. Public Health Service

Major-General Benjamin D. Foulois

Chief of the Air Corps, U. S. Army

Capt. E. Armitage McCann

Founder of the Ship Model Maker's Club

Dr. Francis G. Pease

Astronomer, Mt. Wilson Observatory, Pasadena, Calif.

Frank A. Vanderlip

Banker and Publicist, New York



A boat and doll house made by members of the club at Rockford, Ill., and exhibited at its first annual show. Five thousand visited the exhibition

HOW TO WORK OUT YOUR OWN

Lighting Stunts for Christmas

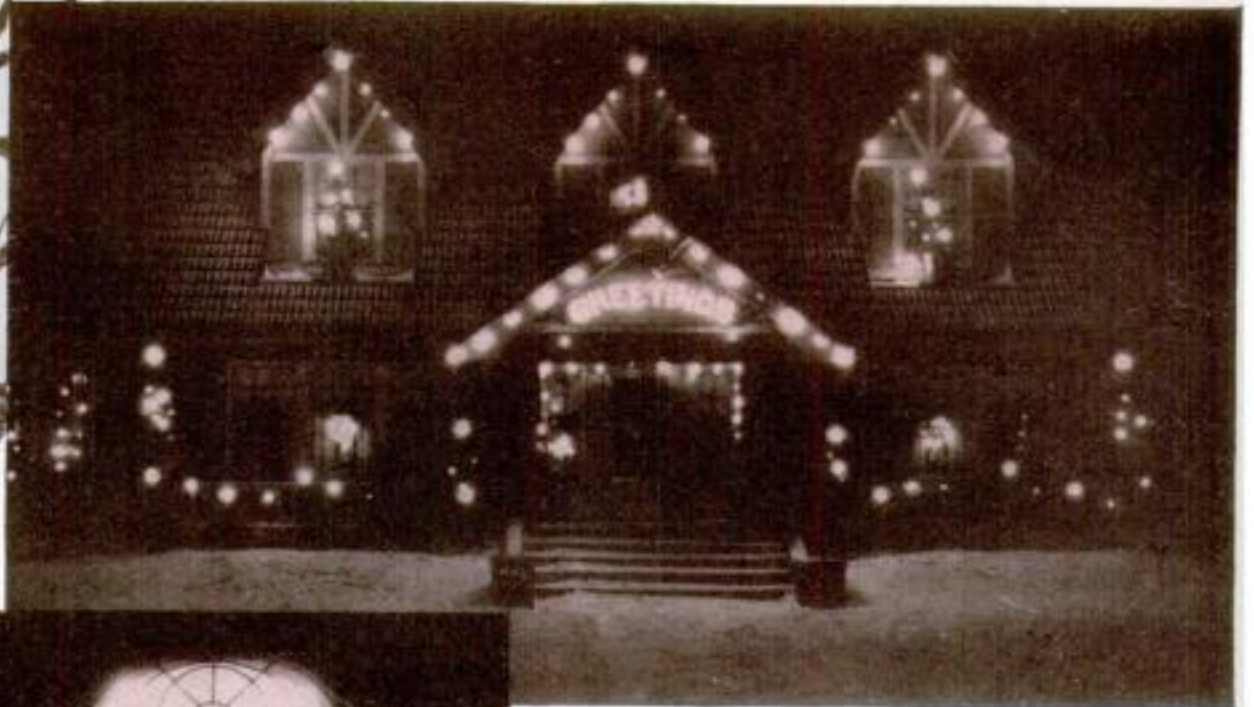


By Roy Elton

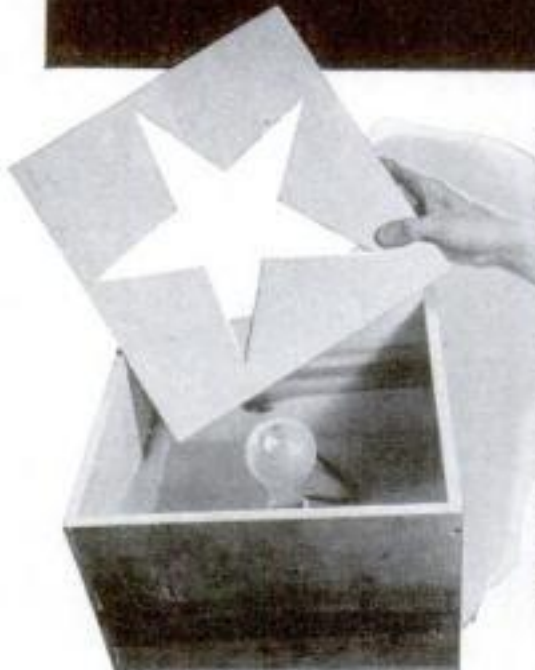
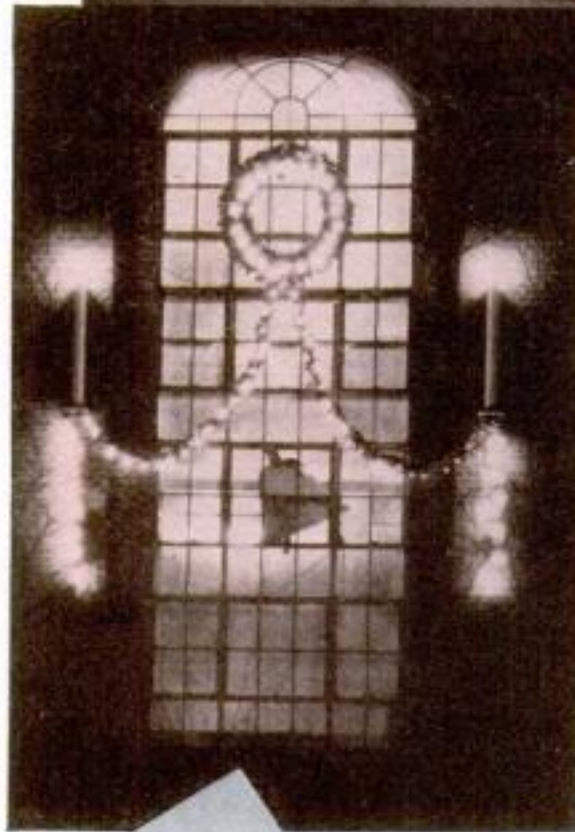
DISTINCTIVE Christmas lighting, either indoors or out, is simple and inexpensive for anyone to arrange. The man who is naturally handy with tools has a further advantage in that he can construct equipment for individual lighting effects, thereby saving considerable money.

Lighting experts have found that the secret of successful Christmas lighting is the basic plan. That is, the lighting scheme should be thought out beforehand, not strung together haphazard.

If your house is attractive in form, one of the simplest ways in which you can express the Christmas spirit with light is to use the entire structure as a background for the display. Lamps strung along the eaves, over the entrance, around the doors, and placed in windows, are invariably striking. But before you attempt to place the equipment, make a sketch of the house or, better still, make a daytime photograph of it. Then, with a brush and show-card colors or similar paints, spot in the lamps. If you make a mistake, you can wash off the show-card paint. While you are doing this, include a few lamps for the evergreens or other shrubs in the front lawn. If there is a hedge, it can support a dozen or two lamps. With your spotted-in



Illuminated cut-out of Santa on roof; a house with lamps artistically arranged; and, at left, a window decorated outside and with silhouetted bell inside

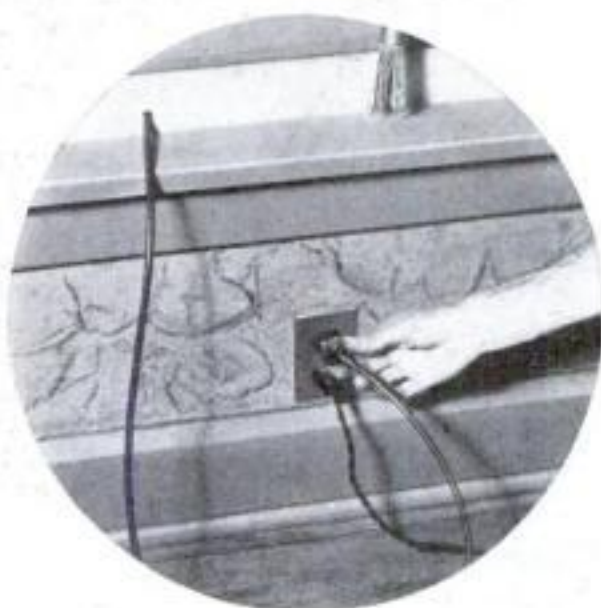


Cutting star on jig saw. At left: Home-made Christmas star light. In circle: Tree made of cut-outs with spaces between

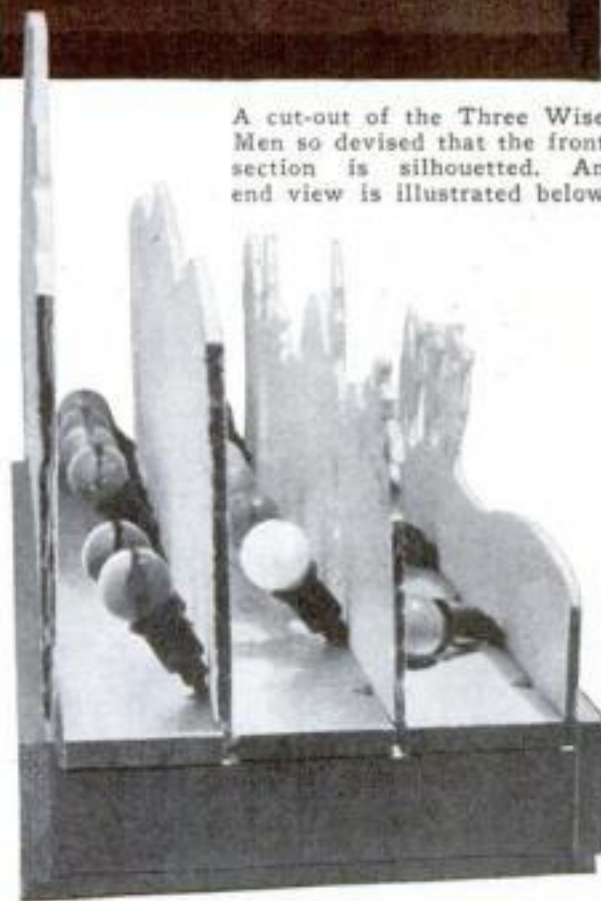


A window vase with 5-watt lamp to cast its rays upwards on the flowers. The reflector is tinfoil. Place such a display so that the window sill conceals the base

A cut-out of the Three Wise Men so devised that the front section is silhouetted. An end view is illustrated below



Wires can be carried outside through a slot in a board set across bottom of window frame



Lighted ice mountain built like a tower with a frame of iron pipe and chicken wire. At right: The proper type of socket to use

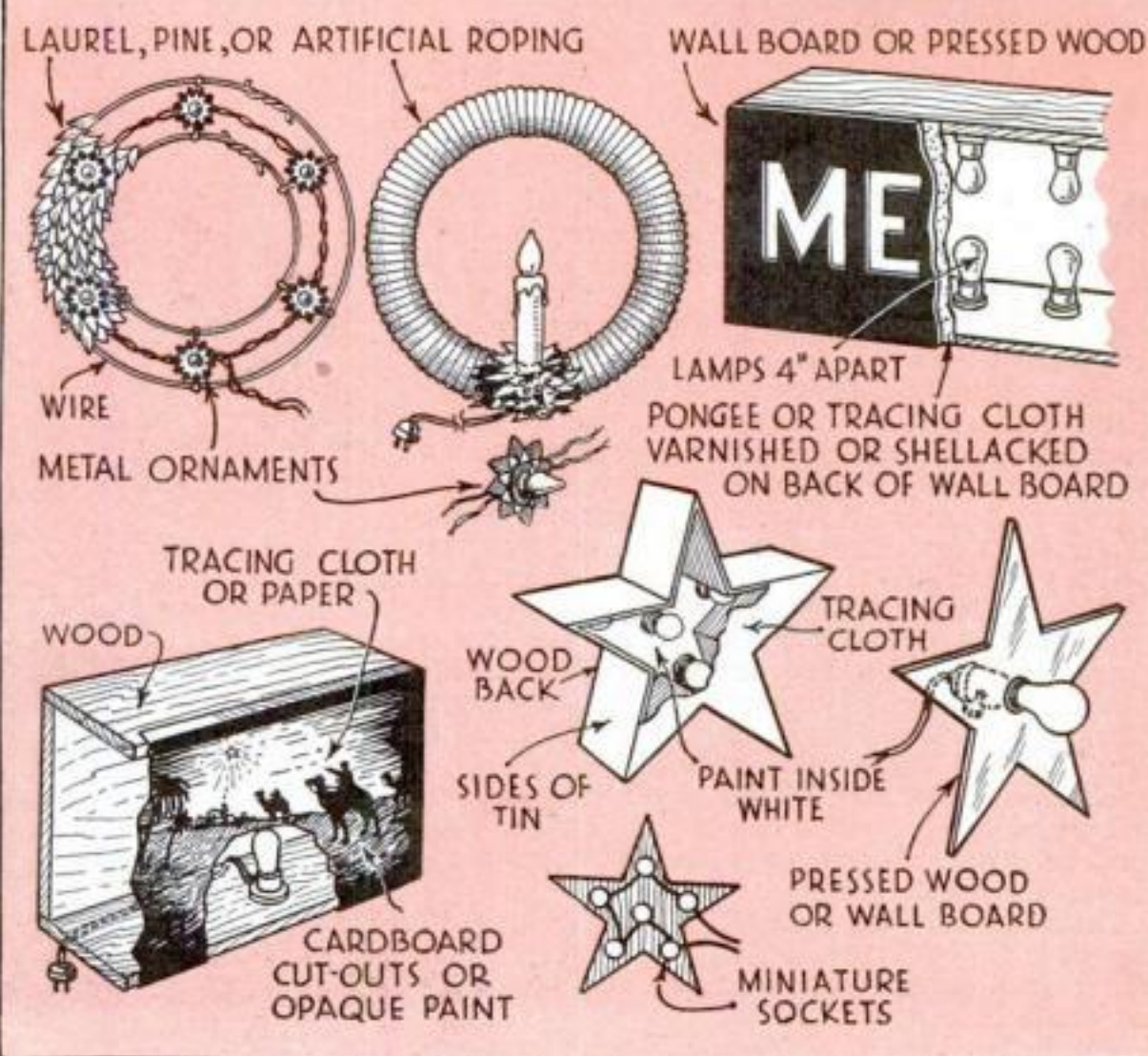


plan, you will find it a simple matter to string lamps of the proper colors wherever indicated.

You can purchase ready-made strings of sockets. There are two kinds. One is an 8-lamp group, with the sockets wired in series, intended for 15-volt Christmas-tree bulbs. The other is a multiple-string group intended for 110-volt lamps of 10 watts or larger size. Small hooks screwed into the siding or placed along window sills or around door frames will afford easy means of fastening the strings without defacing the house.

When used against otherwise bare walls, lamp strings or festoons look better both in the daytime and at night if wrapped with evergreen, laurel, or artificial roping. Simply wrap the covering material around the wires of the festoons, tying it in place at intervals with cord, and adjust the bulbs so that they project through. This work is done before the festoons are hung in place. When using a green wrapping, you will have to exercise a little

(Continued on page 97)



How to prepare two kinds of illuminated wreaths, a greeting, stars, and pictorial scenes

THE SIMPLEST PLANS EVER DRAWN
FOR BUILDING A BEAUTIFUL LITTLE

Clipper Ship Model

THE Sea Witch

BY DONALD W. CLARK



materials, page 82. Plane the piece absolutely square on all sides. Then mark the profiles of the decks, the bow, and the stern with a sharp-pointed pencil, and cut to these with a coping saw. True up with file and sandpaper. Next mark the top plan lines on the decks, which can be done easily by using cardboard templates. Cut away the excess wood to these lines. Round the sides down to curve No. 6 on the body plan and begin to shape the bow and stern portions to the proper form. I used no templates for this work, but relied on my eye. After carefully carving the ends to correspond to the drawing and sanding the surface, your hull should resemble that marked "Step 3" in the sketches. The best time to drill the mast holes is after the decks have been cut in.

The keel, stem, sternpost, and rudder are made of $\frac{1}{8}$ -in. pine or harder wood. They are planed down to $\frac{3}{32}$ in. thick, sawed to the proper shape, and glued in place with casein glue or a good household cement. Time can be saved in making the rudder if a wooden spoon of the kind sold with paper cups of ice cream is used.

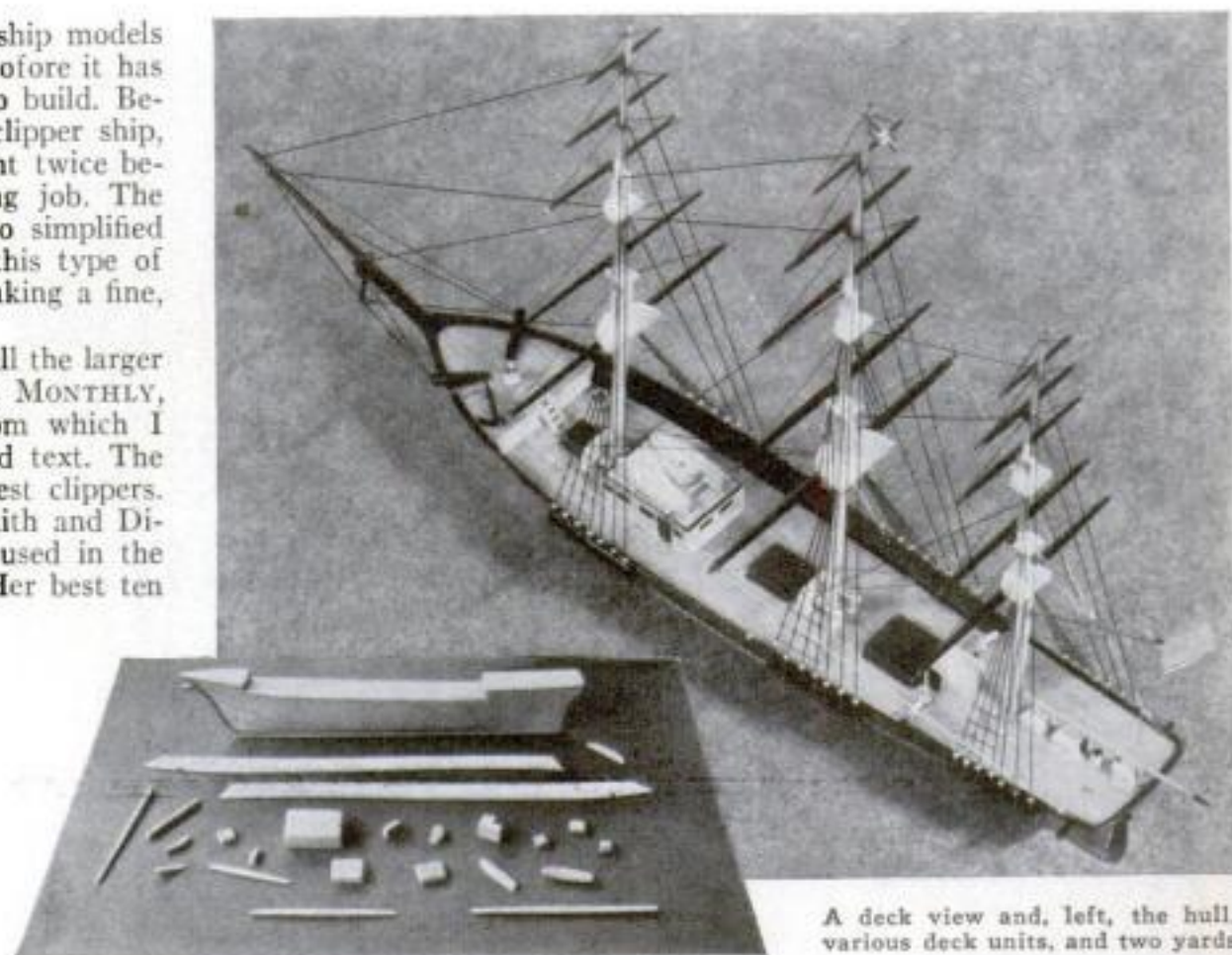
The deck houses, skylights, hatches, and other parts can be made of pine or whitewood. Cut them to size from three different thicknesses as indicated— $\frac{1}{8}$, $\frac{3}{16}$, and $\frac{3}{8}$ in.—and sand smooth. They should be glued in position on the decks on the center line. The fife rails can be made of $\frac{1}{8}$ -in. stock with pieces of safety match sticks glued on as shown in the drawings. The bowsprit

MOST beautiful and popular of all ship models is the American clipper, yet heretofore it has always been one of the hardest to build. Beginners were scared to tackle a clipper ship, and even experienced model makers thought twice before starting such an intricate and exacting job. The accompanying plans, however, have been so simplified that a beginner who has never attempted this type of work before will have little difficulty in making a fine, highly decorative clipper model.

Capt. E. Armitage McCann, who designs all the larger ship models described in POPULAR SCIENCE MONTHLY, supplied the sketches and information from which I worked and later checked the drawings and text. The model is of the *Sea Witch*, one of the fastest clippers. She was built at New York in 1846 by Smith and Dimon for Howland and Aspinwall and was used in the New York, West Coast, and China trade. Her best ten days' run was 2,664 miles—an average of slightly more than 11 knots, and her best day's run, 358 miles. She became a total loss when wrecked on a reef outside of Havana in 1856.

The relation of the model to the full size boat is about $\frac{1}{20}$ in. equal 1 ft. The actual over-all dimensions of the model are 13 in. long and 8 in. high.

The hull can be made from a white pine block of the size given in the list of



A deck view and, left, the hull, various deck units, and two yards

spreader, boat skids, galley pipe, bumpkins, and binnacle can also be made of match sticks. The $\frac{1}{8}$ -in. stock should be used for the catheads, capstan, hatches *E* and *H*, skylight *L*, and companion hatch *M*. The $\frac{3}{16}$ -in. stock should be used to make the two lifeboats, hatch *J*, and the steering gear unit. Cardboard will serve for the wheel, which should be mounted on a pin. The rim and spokes can be painted on, if so desired. The main deck house and house *K* should be sawed from the $\frac{3}{8}$ -in. stock. The latter should have its rear, lower corner removed so it will lap over the foreward edge of the poop deck.

Draw out the bulwarks on $\frac{1}{32}$ in. thick cardboard and trim with a razor blade or sharp knife. Mark the positions of the six channels *P* and the notches to take the catheads. You will note that the foreward lines of the bulwarks curve down, but when they are fitted to the hull, which requires them to be bent in and twisted at the same time, they will take an upward sweep, as seen from the side. Make the channels and the stern piece of the same material and glue in place.

The ladders can be made easily of the same stock by cutting narrow strips $\frac{1}{16}$ in. wide and gluing them together to form the steps as shown in one of the sketches. Glue them in place on the decks.

Hull, deck, and rigging plans with a scale in inches. The yards are shown, for clearness, as if fore-and-aft, but in reality they are braced across, as in the photos

The bowsprit should be made of $\frac{1}{8}$ in. diameter lollypop sticks (or medical applicators may be used if available in the desired size). The top member must be tapered down to $\frac{1}{32}$ in. diameter at the tip. Holes drilled into the hull will support the bowsprit rigidly. The bowsprit cap should be fiber, but the spreader is wood. Tapering is not difficult to do if a coarse wood file is used, followed with a fine file and sandpaper.

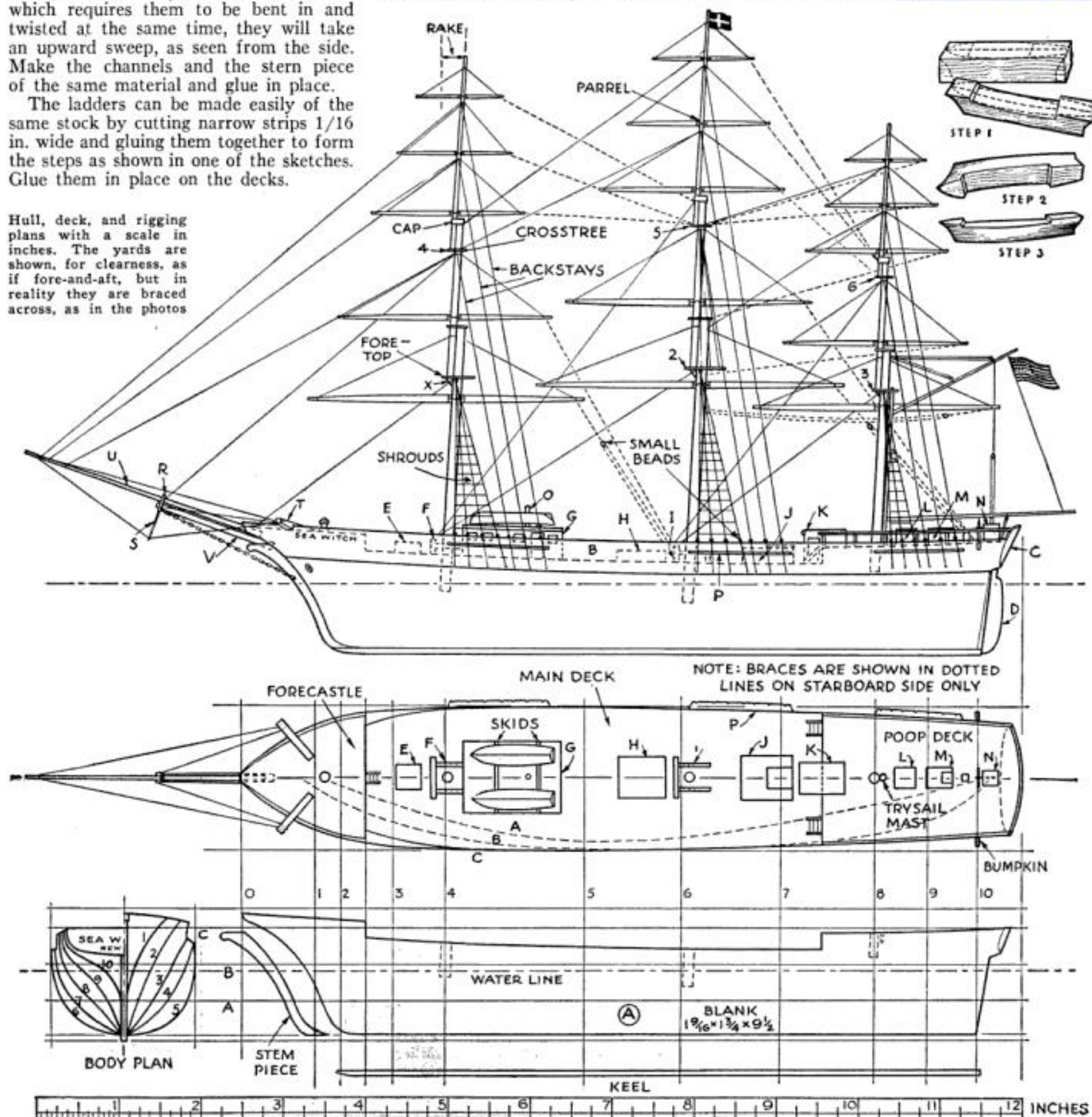
Work can now be started on the masts, crosstrees, and yards. This is a rather delicate job because of the small size of the parts. You will need sixteen or more $\frac{1}{8}$ in. diameter lollypop sticks to build up the masts and for the yards. For the lower-masts use the full diameter. The middle pieces should be reduced as shown, and the upper masts tapered. For the latter large match sticks will serve, but a harder wood is better. The lower yards are lollypop sticks, tapered carefully at

both ends. The upper yards are either applicators or match sticks. Use fiber for the crosstrees and caps. All of the parts of the masts should be bound with fine thread and glued together to form a unit before they are set into the hull.

The trysail mast can be made from a lollypop stick, as was done on the model shown, by reducing it with a coarse file. The gaff and boom can be cut from ordinary match sticks. Fine wire is suitable for fastening the yards to the masts, or they may be glued on, which is much quicker and will hold them in line.

It is important that all three masts line up perfectly. No matter how well a ship is rigged, it will not be pleasing to the eye if the masts are set crooked.

The taffrails, if you wish to add them, can be made of wood or fiber and fastened to the poop deck and bulwarks with glue. They were purposely left off this model in keeping *(Continued on page 82)*



FREDERICK D. RYDER, JR., *tells how to make a*

Camera Record of your HOME



Interior views like that above, made with an inexpensive hand camera, may be as attractive as a professional wide-angle shot such as that illustrated at left

that your camera has an angle of view of not more than 45 or 50 deg. No matter where you stand, you can't take in anything but a fraction of the entire room.

Professionals solve this problem by the use of wide-angle lenses that include everything within 90 deg. or more. Fortunately, however, you can get in enough to make an attractive picture by carefully choosing your point of view. You can make up for the lack of a wide-angle outfit by taking two or more shots in each room if there happen to be a number of features of construction or decoration that you wish to record.

To show what I mean by this, I have taken the interior view at the left above with regular professional equipment. Virtually every item in this particular living room is included in this view except, of course, the wall and corners directly behind the camera. The photograph at the right is a shot taken in the same room with an ordinary hand camera. The picture is just as attractive to look at and, with another shot of the corner where the davenport is (Continued on page 70)

THE time to take a picture is at the first available opportunity. This is especially true of interior views of your own home. Just because you live there and can take pictures whenever it happens to be convenient, the temptation is to put it off from month to month. The result, in all too many cases, is that the pictures are never taken at all.

Why put it off any longer? Start at once to take a series that will form a complete pictorial record of every part of your home. You don't need special photographic equipment. Your regular snapshot camera will do nicely.

When you first start to take interior views, you will encounter three

main problems, but they are easily solved.

You bump into the first problem when you look into the finder to see what the picture is going to be like. You will find

Enter Your Best Prints in Our \$50 PRIZE PHOTO CONTEST

With the new lights and supersensitive films now available, you can take fine indoor photographs. If you have never attempted it before, you are certain to be surprised at the results. It is easier than taking outdoor pictures. Just try it, and enter the best print or prints in our December contest. The prizes are as follows:

FIRST PRIZE.....	\$25
SECOND PRIZE.....	15
THIRD PRIZE.....	5
FIVE PRIZES, \$1 each.....	5
TOTAL.....	\$50

Photographic contests usually have all sorts of conditions, but in this one the only thing that counts is the quality and general interest of the picture itself. The contest is open only to amateurs, but the developing and printing may be done by a professional.

Mail all entries to the Photographic Department, *Popular Science Monthly*, 381 Fourth Avenue, New York, not later than January 2, 1934, and mark them "December Photo Contest." It is not necessary to send the films. No prints will be returned unless a self-addressed, stamped envelope is inclosed. The contest is open to all but employees of *Popular Science Monthly* and their families. In case of ties, each tying contestant will be awarded the prize tied for.

Now it's so easy to make SNAPSHOTS INDOORS



1/25 second at f.4.5. 3 Photoflood lamps
Kodak Super Sensitive Panchromatic Film

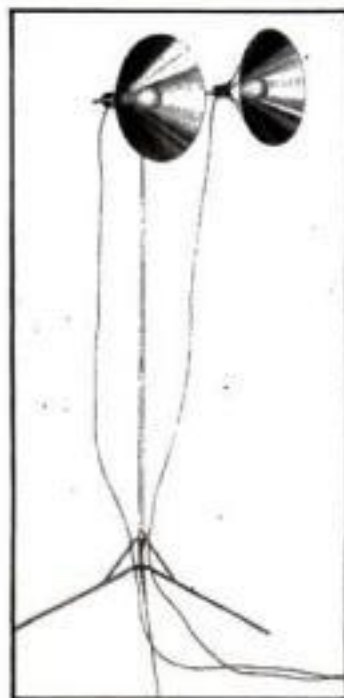
NO tripods...no long poses! Now you can hold the camera in your hand and make snapshots anywhere indoors. You can catch your subjects in unposed, natural attitudes...get the pictures you have always wanted.

Inexpensive Photoflood lamps screwed in the regular room outlets provide the light. Or use the convenient Kodaflector, shown below. With two Photofloods it gives a light equivalent to that of 50 ordinary 100-watt lamps.

Use any Kodak with an f.6.3 or faster lens. You will find either of the two new models at the right ideal.

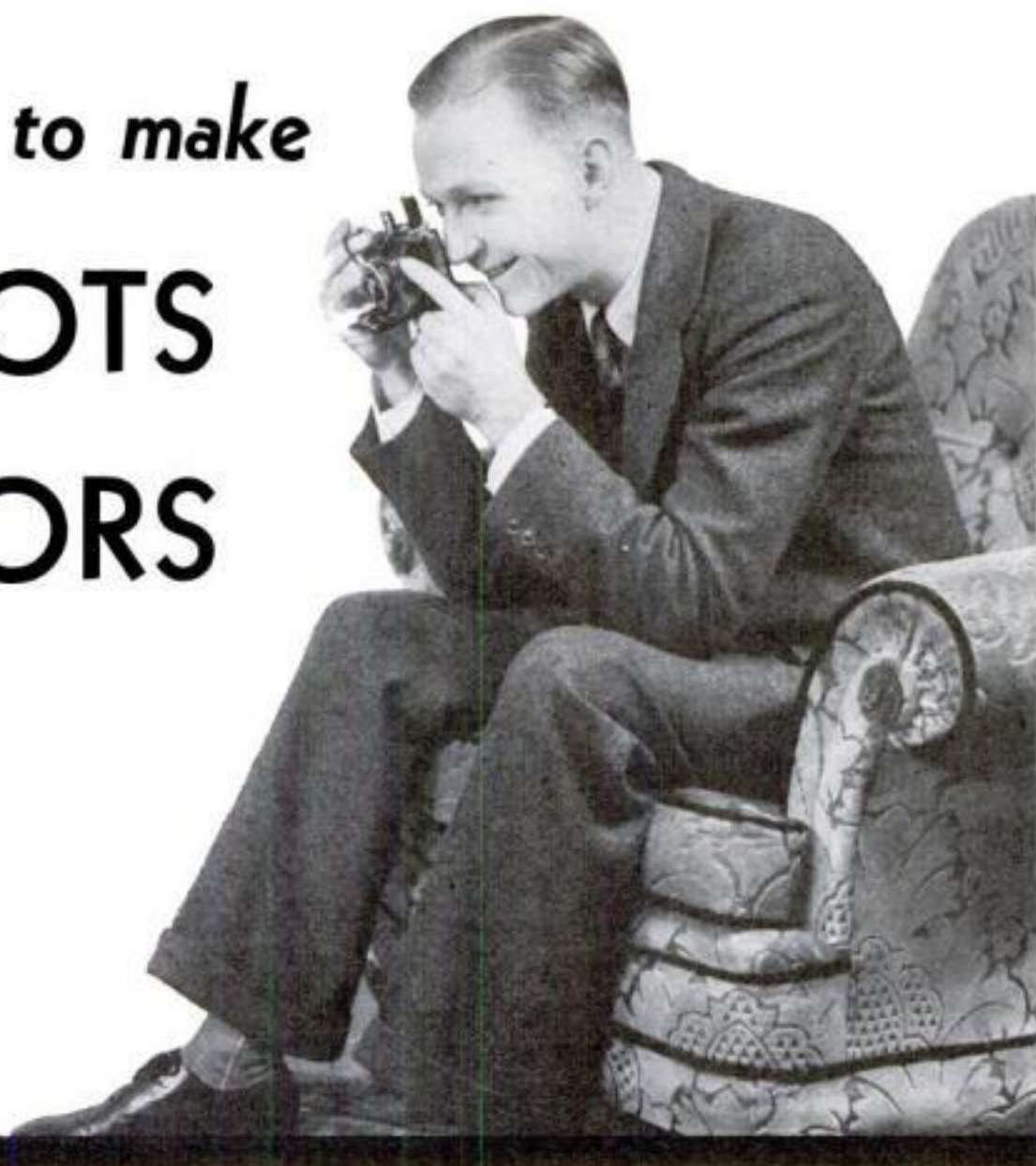
Load with Kodak Super Sensitive Panchromatic or, if you are using a miniature camera, with Kodak Panatomic Film... both these new high-speed films are now obtainable at your dealer's...and discover for yourself the thrill of indoor snapshots.

WITH THESE NEW LIGHTS, FAST FILMS



LEFT. The Kodaflector makes two Photoflood lamps do the work of nine. An efficient, inexpensive home lighting unit. Price, \$5.

BELOW. For indoor snapshots use Kodak "S. S. Pan" or the fine-grain Kodak Panatomic Film. Both are extremely fast under electric light, fully color sensitive. At your dealer's.



...WITH THESE NEW, FAST KODAKS

KODAK VOLLENDIA, seen in action above, is an ideal camera for both indoor and outdoor shots. It is precision-built, compact, easy to use.

The model at the right has an f.3.5 anastigmat lens, 8-speed Compur shutter, and eye-level finder. It takes 16 pictures on a vest-pocket roll of Panatomic Film, the new fine-grain film which makes beautiful enlargements. Price of f.3.5 Vollenda, \$27.50. Vollenda f.4.5, with Pronto shutter and built-in self-timer, \$19.50.



KODAK SIX-16 (left), equipped with the famous f.4.5 Kodak Anastigmat, has ample lens speed for indoor photography. Beautifully designed, it is the world's most compact camera making $2\frac{1}{2} \times 4\frac{1}{4}$ pictures. Has Diodak shutter with speeds up to 1/100 second, and secondary shutter and focusing scales which are clearly visible in picture-taking position. Kodak Six-16, with f.4.5 lens, \$30. With f.6.3 lens, \$17.



*If it isn't an Eastman,
it isn't a Kodak*

EASTMAN KODAK COMPANY, ROCHESTER, N. Y.

P.S.12-33

Please send me your latest camera catalog and booklet telling how to make indoor snapshots.

Name

Street

City State

In a coma from that aroma



TEMPORARY asphyxiation from bad tobacco in a bad pipe." That's what the doctor put in his notebook. And this remorseful husband learned that it isn't only apples that keep the doctor away.

Here's a prescription for keeping wives not only conscious, but happy with a pipe-smoking husband. Ask the tobacco store man for Sir Walter Raleigh Smoking Tobacco. It's that mild, flavorful blend of rare Kentucky Burleys that pleases husbands and wives alike. It's kept fresh in gold foil. When it's packed in a well-kept pipe, it will give you more satisfaction than heavier tobacco, and you could smoke it in a submarine without upsetting the white mice.

Brown & Williamson Tobacco Corporation
Louisville, Kentucky, Dept. Y-312.



It's 15¢—AND IT'S Milder

A CAMERA RECORD OF YOUR HOME

(Continued from page 68)

placed, would really form a better record of that end of the living room than is obtained in the one wide-angle view.

Incidentally, an interior view containing a human figure or even a dog or a cat is at least ten times as interesting as a picture that includes no animate object. Furthermore, it is easy enough to include yourself in such pictures if no other member of the family happens to be available. With plenty of photoflood bulbs for light, the exposure can be kept short enough to be within the range of the automatic settings on the shutter of any good camera, and an automatic shutter release turns the trick.

The second difficulty is in picking the point of view. Here is where most beginners go wrong. Lacking a tripod, they turn to a convenient chair, place the camera on it, and shoot. The result is a picture like the lower photograph on this page, a sort of dog's-eye view of the room. The ideal position for the camera lens is where your eye is located when you have finally selected the point from which the portion of the room you intend to take appears most attractive. Unfortunately, this high point of view, while most natural, cannot be used with the ordinary hand camera because you have to point the instrument downward to take in the features you want. This produces distortion and makes the walls of the room look as though they are falling outward. All the vertical lines in the picture, which should be parallel, converge toward the bottom of the picture.

The solution is a compromise. Place the camera as high as you can get it and still keep it level while taking in the view you want. Amateur tripods are built with this point in mind, and the best position usually will be found with the tripod set just below its maximum height. The upper photograph shows the same view as the lower one except that the camera has been raised to the proper height.

In all cases remember that the farther away you can move the camera, the better will be the picture. Not only will you be able to take in more of the room, but the relative size of objects at different distances from the lens will appear more natural. This means that it is well to take advantage of a door leading to another room. Back through the door as far as you can without having the door frame cut off a part of the view you want.

The third problem, and a difficult one to solve only if you work by daylight, is the matter of giving the proper exposure. The ideal "sure-shot" lighting for interior views is to use either photoflood bulbs or photoflash bulbs. The latter are especially desirable if you add human interest to your pictures by including one or more members of your family.

All interior views should be taken with as small a stop as conditions will permit. If there are no people or animals in the picture, stop down all the way and give a long exposure. With photoflood

bulbs for light and grown-ups in the picture, F/16 or U. S. 16 (the two systems are the same at this point) is the best compromise. Assuming that you are using modern film such as verichrome, the exposure, with five photoflood bulbs in reflectors, when the average distance to objects is around 10 ft. and the room has medium-colored walls and hangings, will be about 5 seconds. That is fast enough for pictures that include grown-ups. With two bulbs in use, the exposure would be increased to 12½ seconds.

One photoflash bulb, with the camera lens at F/8, will give a satisfactory exposure on the average interior view.

Here is a simple rule for calculating indoor exposures by daylight that will give a printable negative nearly every time.

Set your lens at F/16. For a view with medium-colored walls and furnishings, with bright sunlight outside between the hours of nine and three, and two windows, expose 20 seconds. If the day is cloudy, increase the exposure four times. For very light-colored walls and fittings, cut the exposure in two. If very dark, double it. If only one window, increase fifty percent. For northern exposures, double.

As an example, suppose you had to photograph an interior with light-colored walls, only one window, and having northern exposure and the day was cloudy, you would calculate as follows: Cut the standard exposure of twenty seconds to ten because of light walls, and add fifty percent because of the single window, making fifteen. Double because of the northern exposure, making thirty, and multiply by four because of the cloudy day, making two minutes.



The upper view was taken with the camera at the correct height; the lower photo resulted from placing it too low

For real Thanksgiving snapshots TRY THIS NEW LAMP

*.. makes indoor
picture-taking
easy*

only **15^c**



Approximately 3/4 actual size



TO TAKE PICTURES LIKE THE ONE ABOVE, SEE DIRECTIONS BELOW



Think of the thrill of snapping a picture of Grandpa carving the turkey . . . of Jerry digging into a plate heaped high with "trim-min's" . . . and of many other precious indoor scenes! And all you need to make it EASY is some of the new G-E MAZDA Photoflash lamps!

These magic new 15c lamps make it as easy to take vivid, lively pictures indoors as snapshots in sunlight. They eliminate noise, smoke and dust, and can be operated from either light socket or batteries. For best results use them in the new style, inexpensive reflectors.

Photograph the joyous events of Thanksgiving and other occasions—with the new G-E MAZDA Photoflash lamps. Your druggist or camera dealer has them. General Electric Co., Nela Park, Cleveland, Ohio.

FREE—Write for an interesting new
booklet on INDOOR picture-taking

GENERAL  ELECTRIC
MAZDA PHOTOFLASH LAMPS



Set the camera for "time" and place on a table or tripod. Focus, if necessary. Then insert a G-E MAZDA Photoflash lamp in the reflector. You do not need to put out room lights.



When ready to take the picture, open the camera shutter, flash the lamp by pressing the reflector button and close the shutter. It is as easy as taking snapshots outdoors.

New Hints for Car Workers



Ideas That Save Time and Trouble In Repairing Autos Submitted by Our Readers

Pressure-type garden sprayer can be used, as shown, to shoot lubricant into all parts of car

A battery clip, arranged as shown, is useful in keeping the rubber floor covering out of the way when you work on battery



DURING the months when your pressure-type garden sprayer lies idle, you can put it to good use oiling your car's chassis and springs. Charged with a half-and-half mixture of crankcase drainings and kerosene it will form an excellent pressure oiler. Shooting the lubricant out in a fine spray, it will force the oil between even the tightest spring leaves and chassis parts. If your particular sprayer is fitted with a rubber sealing washer, replace it with one cut from leather as the oil soon will swell the rubber. Incidentally, putting the sprayer to this use will in no way injure it. As a matter of fact, the oil will tend to protect the tank from corrosion and rust during the fall and winter.—W. H.

Trick for Cable Clamps



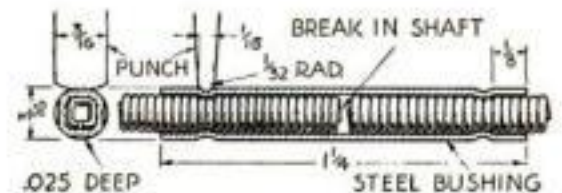
A rubber washer around terminal post keeps cable clamps from sticking

AFTER trying all sorts of tricks to prevent the cable clamps on batteries from sticking to the battery terminals, I hit on the following idea that seems to work better than all the rest: First I cleaned the clamps and terminals thoroughly. Then I selected a large rubber washer that was a tight fit for the terminal post, slipped it over the post, forcing it down next to the terminal base, and fastened the cable clamp in place on top of it. So far the clamp has remained clean.—E. J. N.

To Hold Floor Covering

WHEN you do work around a battery located under the floor boards, you will find a battery clip having a wire hook bolted to it a very useful tool. The rubber floor covering that always persists in getting in the way, can be held back merely by snapping the clip on one corner of the mat and looping the hook around the gear-shift lever or brake rod.—E. G.

Fixing Speedometer Shaft

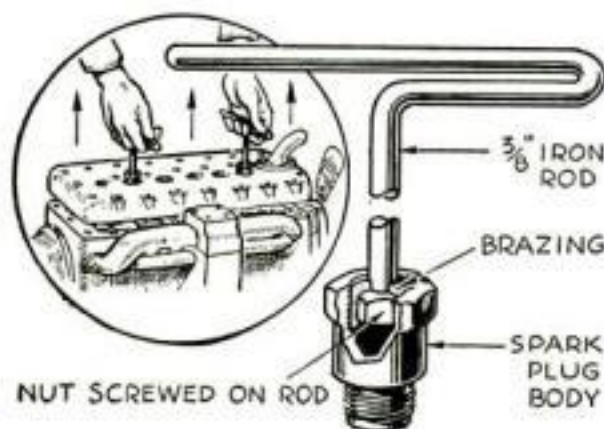


A steel bushing, cut to fit snugly, makes a good repair job when speedometer shaft breaks

WHEN the shaft of your speedometer breaks, you can make a permanent repair by fastening the broken ends with a steel bushing or sleeve. If you can't find a piece of thin-walled steel tubing that will slip snugly over the shaft ends, drill a short piece of three-sixteenths-inch cold-rolled steel rod to be a tight fit. Insert the broken shaft ends into opposite ends of the bushing and, using a curved-tip punch, force the bushing wall into the shaft at four points about one-eighth-inch from each end to hold it in place and prevent it from twisting loose.—J. E. K.

Cold-Weather Washing

IN FREEZING weather, many car owners find it hard to wash their cars in the open without having the water freeze on the body. If you have a little radiator glycerine on hand, add two parts of it to every hundred parts of the water you use. It will prevent the water from freezing even when the temperature is very close to the zero mark.—J. L.

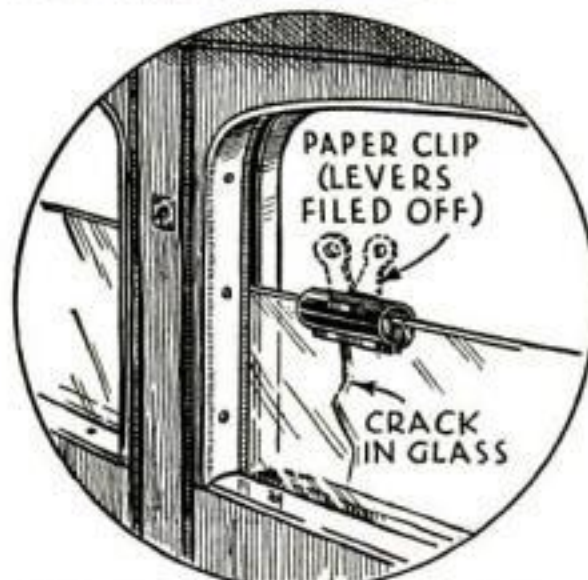


Removing Cylinder Head

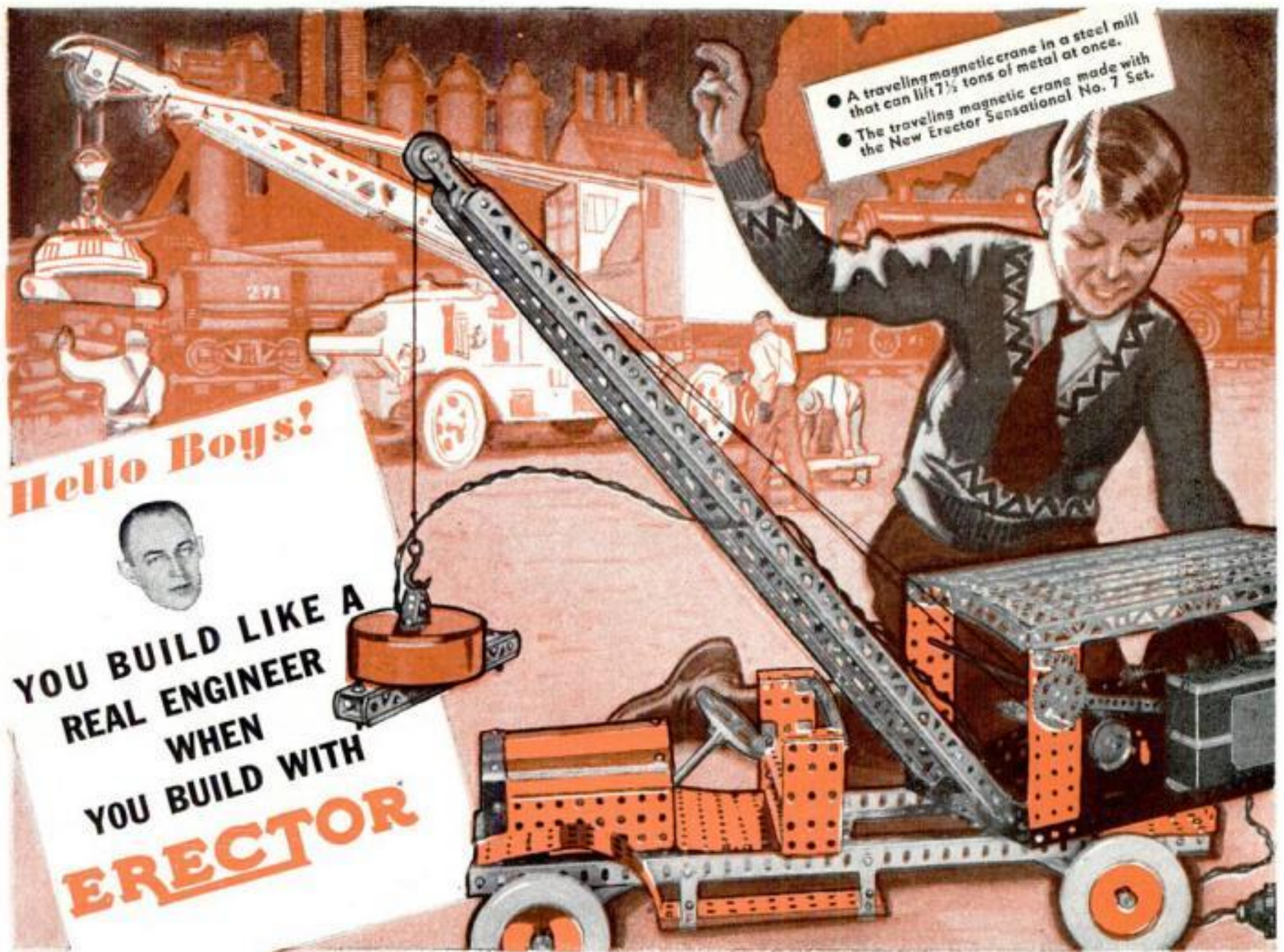
THE job of removing cylinder heads can be made less of a physical task by improvising the simple handles shown in the illustration. Made by fastening fifteen-inch lengths of three-eighths-inch diameter iron rod to the bodies of discarded spark plugs, these sturdy handles can be screwed quickly into the motor head. First remove the porcelain from the spark plug. Thread one end of the rod to take a nut, insert the rod and the nut into the body of the plug, and braise over the top to hold the nut firmly in place. The outer end of the rod can be bent to form a convenient handle as suggested in the drawing.—E. W. B.

For a Cracked Window

IF THE window in your car's door cracks vertically, you can make a neat emergency repair by using a small paper clip of the steel-spring variety. Fasten the clip in place over the upper end of the crack as shown, shear off the two handles close to the spring, and file off any rough edges. The pressure of the clip will hold the broken edges together.—A. C.



Steel-spring paper clip comes in handy to repair, in an emergency, a window that is cracked



HOW would you like to be an automobile engineer and build a big motor truck? Put it together—piece by piece—with your own hands. How would you like to construct a giant steam shovel, with a real electric motor—and make it work just like the ones you see on the highways? How would you like to build a drawbridge that actually opens and closes—a towering ship crane such as used in Uncle Sam's Navy Yards—a mighty hoisting engine—an aeroplane—and dozens of other thrilling engineering marvels?

Does that sound like fun? I'll tell you, boys, being an engineer is the most exciting thing in the world. And that's just what you are when you have one of my New Erectors.

BIGGER AND BETTER THAN EVER This year I completely re-designed and modernized Erector. It's twice as much fun as ever before. You can make more realistic models. You can make them easier and quicker.

TUNE IN "Engineering Thrills"

True stories about real engineers and their hair-raising adventures in digging the Panama Canal, building bridges and skyscrapers.

WJZ Network—Sundays, 6:45 P.M.—E.S.T. See local program listing.



**THE NEW ERECTOR
Sensational No. 7 Set**

Contains the powerful Gilbert 110-volt motor, all-purpose gear box, girders, gears and other real engineering parts for building magnetic crane, fire engine, automatic elevator and over 160 action models.

Erector Sets start at \$1.00. Be sure to see the Famous No. 4—the "Super-6" Erector—and the Sensational No. 7.

**My Great Erector Prize Contest—
Free Automobile—Grand Total of
1,021 PRIZES!**

Now I have another thrilling Erector event to tell you about. The most stupendous metal-model prize contest ever held. First prize is a free trip to the Panama Canal, or Boulder Dam or the Empire State Building or any other engineering project in the United States you would like to see. Second prize: a brand-new Chevrolet automobile. And over 1,000 other prizes.

● I am positive every red-blooded boy will want to be an Erector Engineer this year. So right now, do these two things. First, mail the coupon below, and I'll see that you get my big illustrated "Look-Em-Over" Book and an entry blank for the prize contest. Then go to the nearest toy store and pick out the Erector you want. Take your Dad along. He'll want to share in the fun... And good luck in my big prize contest.

Your friend,

A.C. Gilbert

FREE CLIP THE COUPON

Mr. A. C. Gilbert, The A. C. Gilbert Company, 381 Erector Square, New Haven, Conn.

Send me the big colored Erector "Look-Em-Over" Book and entry blank for the Erector prize contest—both free.

Name _____ Address _____

City _____ State _____

Genuine EVEREADY PRESTONE

The same safe, all-winter anti-freeze sold last year for \$4.45.
Concentrated—not diluted or cheapened in any way.

TWO MINUTES OF YOUR TIME in reading the facts on this page may save you many hours of driving-discomfort this winter. Do not wait until the first freezing day comes to decide the kind of anti-freeze you want. The economy and safety of your winter driving will depend upon how well you choose. It is important that you learn the facts *now*.

Economy plus safety

You know this about anti-freezes. There are two types—the “boil-away” kind and the “permanent” kind that is supposed to stay right on the job throughout the winter. Boil-away anti-freezes smell up the car. They are inflammable. They evaporate in warm weather, and leave your car unprotected against the next cold snap. Their one appeal in the past has been their low initial cost.

But today, at the new low price of \$2.95 per gallon, Eveready Prestone is within the reach of all. And, of course, in *all-season* cost it offers real economy. That's because one filling of Eveready Prestone gives you complete protection all season long. No replacements, no costly repairs for frozen engines, no rust, no worry about the protection in your radiator. It's there to stay!

Permanence plus rust protection

With Eveready Prestone you get this permanent anti-freeze protection without the *penalty* of a rust-clogged radiator and overheating.

Many so-called “just-as-good” anti-freezes are being offered. Some give protection *for a limited time*; others are immediately harmful to your car. To bring you the cold, scientific truth, “permanent” anti-freezes have been subjected to exhaustive tests—the most rigorous ever conducted.

For hundreds of hours, each product was run through an automobile cooling-system at a speed and engine-temperature *exactly duplicating actual driving conditions*. Under this test Eveready Prestone was unchanged after 1000 grueling hours—still giving full protection *not only* against freezing, but against rust and corrosion. Other anti-freezes, in the same test, broke down and became *definitely corrosive* to the cooling-system in from 50 to 200 hours . . . developing “anti-freeze rust,” a common cause of radiator clogging and overheating.



If, for example, your average driving speed on the road is 25 miles an hour, this test means that Eveready Prestone will protect your car for 25,000 miles of driving and upwards.

Do not confuse Eveready Prestone with either alcohol or glycerine

There is no other anti-freeze “the same as Eveready Prestone” . . . or anything like it. Eveready Prestone is a distinctive, patented product. It protects your car not only against freezing, but also against rust and corrosion in the cooling-system. Its use reduces the corrosive action of water on cast-iron 95%; on other metals of the cooling-system, 75%.

Eveready Prestone is approved by every car-manufacturer in America, as well as by all leading radiator makers.

Don't buy water when you can get it out of the spigot

Don't be fooled by “tricky” prices. Laboratory measurements show that many “permanent” anti-freezes are nearly *half* plain, ordinary water. Eveready Prestone is concentrated—all anti-freeze. Here's a little revealing arithmetic:

For a 1933 Plymouth

Suppose an anti-freeze which is one-half water sells at \$1.50 a gallon, requiring 2 3/4 gallons to protect a 1933 Plymouth to 10° below zero	\$4.31
Amount of Eveready Prestone needed to protect to 10° below zero is 1 1/4 gallons at \$2.95 a gallon	3.72
	Saving \$.59

plus safe protection from rust and corrosion.

Read this guarantee

National Carbon Company, Inc., specifically guarantees that Eveready Prestone, if used according to directions, will protect the cooling-system of your car against freezing and clogging from rust formations for a full winter; also that it will not boil away, will not cause any damage to car finish, or to the metal or rubber parts of the cooling-system, and that it will not leak out of a cooling-system tight enough to hold water.

At the new low price, Eveready Prestone is the cheapest and safest anti-freeze you can buy for *all-winter protection* against freezing and rust. Have it put in now. It won't evaporate, or heat up your motor. With Eveready Prestone in the car, the anti-freeze question is off your mind for the *entire winter*.

Tested  Approved

NATIONAL CARBON COMPANY, INC.

General Offices: New York, N. Y.

Branches: Chicago New York San Francisco

Unit of Union Carbide  and Carbon Corporation



now **\$2.95** *a gallon*



← This Studebaker (Comm. 73, '33) can be protected to 10° above zero with 1 gal. of Eveready Prestone at a cost of \$2.95.

This Oldsmobile (Model F33, 6, '33) can → be protected to zero with 1½ gals. of Eveready Prestone at a cost of \$4.45.



FIND YOUR OWN CAR ON THIS CHART. If your car is not listed, see your dealer. He has a complete chart showing every car made. The amounts of Eveready Prestone required, as shown here, do not allow for the capacities of hot water heaters. If you have a hot water heater, or if you need to protect your car to any lower temperature, down to 60° below zero, consult your dealer.

The important thing in buying an anti-freeze is to figure cost to a definite protection point, not the price per gallon. See how reasonably you can get all-winter protection against freezing and rust with Eveready Prestone.

GALLONS OF EVEREADY PRESTONE NEEDED TO PROTECT TO THESE TEMPERATURES

CAR	MODEL	10° above	Zero	10° below	CAR	MODEL	10° above	Zero	10° below
Buick	32-50, '32; 33-50, '33	¾	1	1¼	La Salle	340, '30; 345, '31	1½	2	2½
	40, '30; 32-60, '32	1	1½	1¾		345, '32; 345-C, '33	1¾	2¼	2½
	50, 60, '30; 33-60, '33	1½	2	2¼	Nash	6-60, '31; 960, '32	¾	1	1¼
	8-80, 8-90, '31; 33-80-90, '33	1¾	1¾	2		880, '31; 980; 1130, '33	1	1½	1¾
	32-80, 32-90, '32	1¾	1¾	2		8-90, '31; 990, '32	1½	2	2¼
Cadillac	355, '31; 370, '32; 370-C, '33	1½	2	2½		Std. 8, '32; 1170, 1070, '33	1¾	1¾	1¾
	370, '31; 355, '32; 355-C, '33	1¾	2¼	2½		Spec. 8, Twin Ign. '32	1½	1¾	2¼
	452, '31; 452, '32; 452-C, '33	1¾	2¼	2½		Amb. 8, Twin Ign. '32	1½	2	2¼
Chevrolet	'29, '30; Stand. '33	¾	1	1	Oldsmobile	F32, 6, '32; F33, 6, '33	1	1½	1¾
	'31, '32, '33	¾	1	1¼		L32, 8, '32; L33, 8, '33	1¾	1½	1¾
Chrysler	6, '31; 8, '31; 6, '32, '33	1	1½	1¾	Packard	1001-2, 1003-4, '33	1¾	1¾	2
	C.Q., C.L., '33	1¾	1¾	2		826, 833, '31; Std. '32	1¾	1¾	2
	Imperial Custom, '32, '33	2	2½	3		745, '30; 845, '31; Del. '32	1¾	2¼	2½
De Soto	6, '31, '32	1	1¾	1½		1005-6, '33	2½	3¼	4
	8, '31, '32; 6, '33	1	1½	1¾	Pierce-Arrow	54, '32; 836, '33	1¾	2	2½
Dodge	6, '33	1	1½	1¾		51, 52, 53, '32	2½	3½	3¾
	8, '33	1¾	1¾	2		1236, 1242, 1247, '33	2½	3½	3¾
Essex	'29, '30, '31, '32	1¾	1¾	2	Plymouth	'31, '32 Fltg. Power	1	1¾	1½
Essex Terraplane	6, '33	¾	1	1¾		Six; De Luxe '33	1	1¾	1¾
	8, '33	1	1½	1¾	Pontiac	'29, '31; 6, '32; 8, '33	1	1¾	1½
Ford	A, '28, '29, '30, '31, '32	¾	1	1¾		8, '32	1¾	2	2½
	V-8, '32, '33	1½	2	2¼	Studebaker	Diet. '31; 82, '33	1¾	1½	1¾
Hudson	8, '30; 8, '31, '32, '33	1¾	1½	1¾		6, '32	¾	1	1¾
	SS, '33	1	1¾	1½		Diet. 8, '32; 6, '33	1	1¾	1½
Hupmobile	H, U, '30; H, '31, '32	1¾	2¼	2¼		Com. 8, '32; Com. 73, '33	1	1½	1¾
	L8, '31, '32; 321, '33	1	1½	1¾		Pres. 8, '32	1½	1¾	2¼
	226, '32; 326, '33	1½	2	2½		92, '33	1½	2	2¼
	222, '32; 322, '33	1½	1¾	2¼					

COST OF EVEREADY PRESTONE

½ gallon . . . \$1.50	1¼ gallons . . \$3.72	2 gallons . . . \$5.90	2¾ gallons . . \$8.12
¾ gallon . . . 2.22	1½ gallons . . 4.45	2¼ gallons . . 6.67	3 gallons . . . 8.85
1 gallon . . . 2.95	1¾ gallons . . 5.17	2½ gallons . . 7.40	3¼ gallons . . 9.62

How many of your friends like the same things you do?

LIKE many other good people you want to make this Christmas as merry and happy as the budget will allow.

That's why we think we have a plausible, intelligent suggestion to make to you.

Our suggestion is based principally on the fact that *you* read and, we hope, enjoy Popular Science Monthly. For if you do, there are undoubtedly many among your friends who might feel the same way. Men, or boys, who may have picked up the magazine in your home, thumbed through it, sat down with it—and found a magazine they genuinely like. Something that gave them a stimulating hour or two—something different from the ordinary run of magazines.

But we don't have to tell you about Popular Science Monthly. Whether this is the first or hundredth time you've read it, you have by now a clear picture of its merits and its fascination for the alert-minded man who likes to know about the marvelous things science and invention are constantly contributing to the comfort of our daily lives.

Surely some of these friends would get the same "kick" out of Popular Science that you get. For very little money, then, you can be instrumental in bringing them

this pleasure—not just temporarily but all through the year.

And here's something your pocketbook will be interested in. The regular subscription price of Popular Science Monthly is \$1.50 a year. For Holiday Gift Subscriptions, though, it's only \$1.25—this reduced rate is our own Christmas gift to every reader who wants to send the magazine to his friends. Your own subscription or renewal may also be included at this price if you are ordering one or more Gift Subscriptions. If you include your renewal your present subscription will be continued for one year beyond its present expiration date. The first copy on each Gift Subscription will come in time for Christmas. And we send to each friend on your Gift list an appropriate Gift Card in color. It will bear your name, and announce that Popular Science is coming all through the year as your gift.

RECALL the practical-minded men and boys you know and write their names down NOW on the handy order form below. Do it now, while this page is before you and see how you'll relish the sense of relief that comes from knowing that you have selected a gift that will bring to your friends the same year-long pleasure and profit that you get out of it.

POPULAR SCIENCE MONTHLY

381 Fourth Avenue New York, N. Y.
Send Popular Science Monthly for one year on your special Christmas offer of \$1.25 for a year's subscription to the names written below—and also send a Christmas Card bearing my name and greetings for each separate gift subscription.

I am enclosing \$..... to cover these subscriptions.
Bill me \$.....after the Christmas Holidays.
(If you wish to pay later, indicate it above)

Put Your Own Name and Address Here

(We may need it for correspondence, billing, etc.)

Name

Address

City

Enter My Subscription 1 yr. ☐ 2 yrs. ☐

If you are including your own subscription or renewal check one of these boxes.

Write below the names and addresses to which you wish to send the Magazine

Name

Name

Name

Address

Address

Address

City

City

City

Knotted Cord Key Case

Introducing an entirely new way to make colorful designs in any type of square-knot work

By
KENNETH
MURRAY

SINCE the time when Columbus is supposed to have bartered square-knot articles with natives of the West Indies, few have been the new ideas advanced for elaborating this type of handicraft, which has now become so popular. In making this knotted key case, however, a real departure has been introduced in carrying out various designs in bright colors. Once the method is understood, it will be found easy of application in any square-knot project. Indeed, extra cords of contrasting colors may be started and ended anywhere without interfering with the regular order of knotting. Initials, borders, and designs of many kinds may be made.

Required are twenty-three brown cords 60 in. long, one yellow cord 36 in. long, one brown or black snap fastener set, and one 6-hook swivel key plate.

Make two rows as shown in Fig. 2. Then proceed as in Fig. 3 and continue with each succeeding knot, excepting the last, entirely across the piece. This will leave a spot of yellow cord in each knot, forming the design. In knotting succeeding rows, the yellow is worked into the knots directly under the second and twenty-first knots of the first row, to form a border around the edge of the key case.

After the first row it will be necessary to hold the work on the edge of a table with pushpins, allowing the original filler cord to hang down at the sides. This is kept a part of the work by making a double half-hitch around it at each side of the piece with the outside cord at every other row (see Fig. 4). When the work is 3 in. long, bring the yellow cord ends back to the middle. They should cross inside a knot, as in the small circle. Apply a drop of cement, draw the knot up tight, and cut the yellow cord off short from the back. Make several more rows of knots; then bring the filler cord ends in from the sides, making tight half-hitches over them with the others. The row of hitches will be crowded, so but one turn can be made with some of the cords. A little cement should be applied and the ends of the cords cut off short with a razor blade.

The key plate and snap fastener are easily made fast with the tools illustrated. Take care to pass the rivets of the plate and posts for the fastener through the open centers between the square knots.

This is the ninth in a series of articles on knot work. For other designs and methods see P. S. M., Nov., '32, p. 77, Mar., '33, p. 68, April p. 75, May p. 63, June p. 82, July p. 65, Sept. p. 65, and Oct. p. 67.



Fig. 1. The necessary key plate and hooks can be obtained from a dealer in leatherwork supplies or removed from a ten-cent key case

Fig. 3. After tying the first half of the second knot of the third row, pass the middle of the yellow cord through it as illustrated at the right, after which the second half of the knot is pulled tight. Continue as shown below



Fig. 2. Start by tying the middle of one brown cord between two screw eyes 7 in. apart, and on it knot the other twenty-two cords, which are all doubled. Separating the cords into fours, make two complete rows of plain square knots

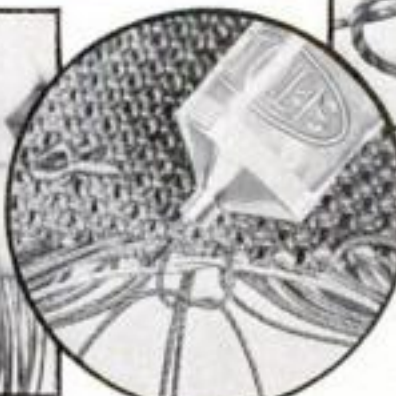
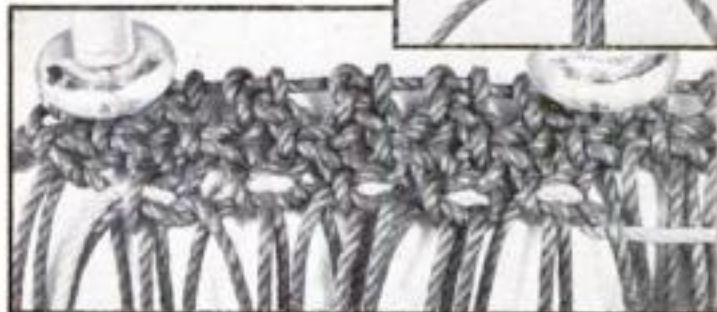
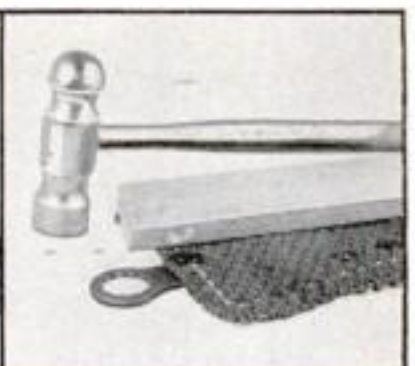
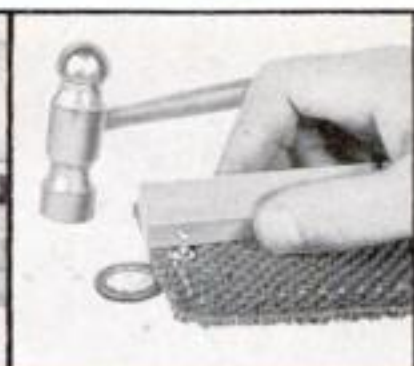


Fig. 4. The filler cord is held to the sides with half-hitches made with outside cords. In circle: The yellow cord is brought together at bottom, cemented, knotted, and cut off short. At left: Finishing bottom with half-hitches tied over filler cord



Rivets are inserted through the spaces by placing them over the end of a nail set. Secure the fastener by using a piece of hardwood with a small hole which may be set over the spring. Tap the wood until spring and post are joined. Then use a larger hole to clinch the top part

CONSTRUCTION KIT for Miniature Clipper Ship

POSTPAID COMPLETE \$1.50

CHRISTMAS is the time to take full advantage of the many remarkable construction kits offered by the Popular Science Homecraft Guild. This month's new kit, for example, contains all the materials for making a simplified but beautiful little model of the famous American clipper ship *Sea Witch*, and the price is only \$1.50. It would be an especially fine Christmas present, whether you actually constructed the model yourself and gave it away complete or merely sent the kit to someone you think would like to take up the hobby of ship model making.

The new clipper ship kit is marked *J* in the list below. It contains the hull block, sawed carefully to the approximate shape, and materials for the deck fittings, spars, and rigging.

Other ship models that are small, simple, and comparatively easy to assemble and therefore suitable for beginners are those marked *F* and *H*. The furniture kits Nos. 2, 4, 5, and 6 are also so quickly assembled that anyone can make them up in time for Christmas. All kits are accompanied by instructions or blueprints.

A. Whaling ship model *Wanderer*. All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153, and 154 and a booklet. The hull is 20½ in. long \$6.90

AA. Same with hull lifts sawed carefully to shape 7.40

D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet 6.45

DD. Same with the two main hull blocks shaped 6.95

E. Battleship model, U.S.S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200 6.95

EE. Same with hull lifts sawed 7.45

F. Liner *Manhattan*. All raw materials

(except paints) for a simplified miniature model 12 in. long, and Blueprint No. 204. 1.00

G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 209... 6.75

GG. Same with hull blocks shaped.... 7.25

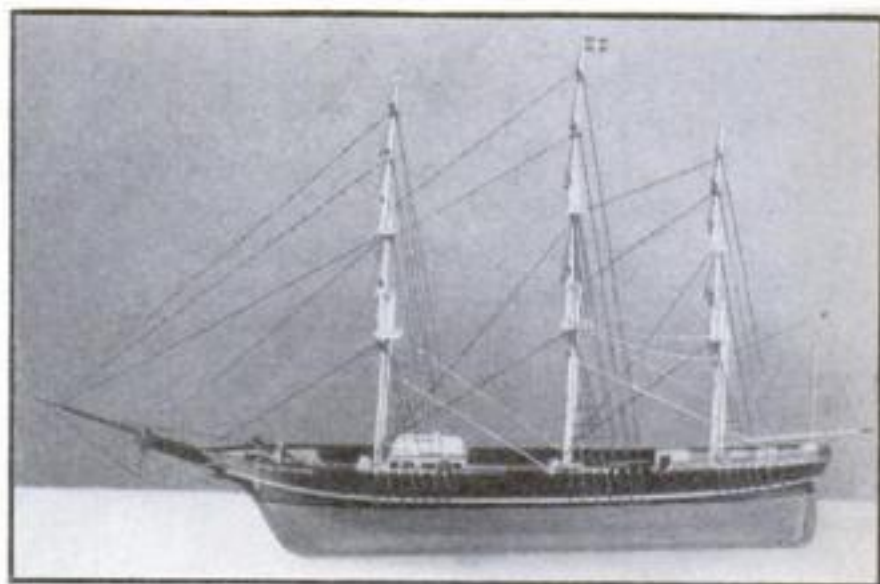
H. Cruiser U.S.S. *Indianapolis*. All raw materials (with enamels) for a simplified 12-in. model, and Blueprint No. 216.... 1.50

J. Clipper ship *Sea Witch*. All raw materials (except paints) for a simplified 12-in. model, with blueprint..... 1.50

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble, but without finishes..... 5.40

No. 4. Solid mahogany book trough 22½ in. long, 9¼ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes.. 5.30

No. 5. Solid rock maple hanging wall



KIT J contains materials for this beautiful little clipper ship

rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included 5.75

No. 6. Solid rock maple butterfly table, top 19 by 22 in., height 22½ in. Ready to assemble and stain included..... 6.90

NOTE: In addition to these construction kits, POPULAR SCIENCE MONTHLY offers blueprints alone for many projects. A complete descriptive list of these will be sent to anyone who incloses a stamped envelope.



NO. 6



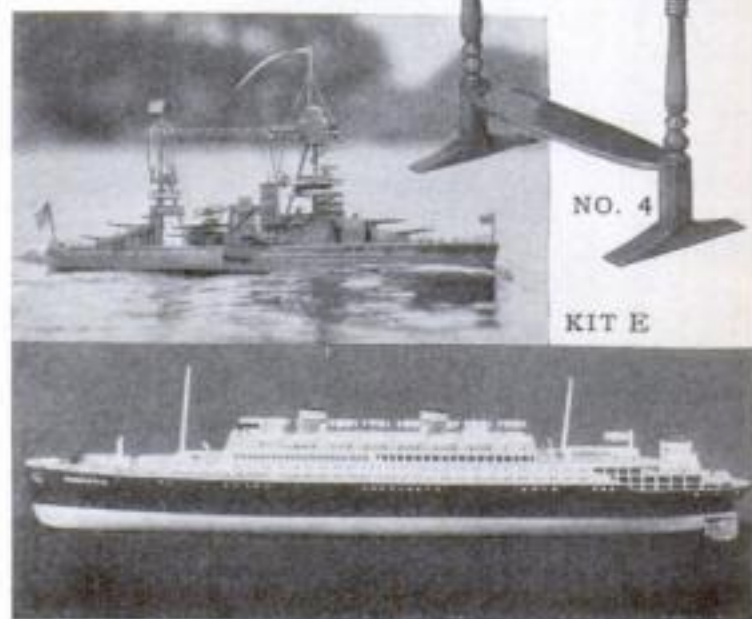
KIT D



KIT E

NO. 4

KIT E



KIT F—Materials for 12-in. model of *Manhattan*



KIT H



NO. 5



NO. 2



KIT A

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.
Please send me Kit..... for
which I inclose \$..... (or send C. O. D. ☐)

Name

Address

City State
(Please print name very clearly.)

Note: Prices of all kits except *F*, *H*, and *J* are 50 cents higher west of the Mississippi River because of heavy shipping charges. We prepay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office, which amount to 28 cents. Kits *F*, *H*, and *J* cannot be sent C. O. D. This offer is made only to readers in the United States.

The new G. P. A. can take it!

On warm days as well as on cold ones

WARM DAYS. G. P. A. will not evaporate no matter how warm it gets.

An anti-freeze that evaporates on warm days is unsafe, because even the coldest winter has many warm days. Weather Bureau figures show that in the majority of U. S. cities, winter's warmest days are at least 70 degrees warmer than the coldest days—in some cases as much as 117 degrees warmer.



COLD DAYS. Complete protection against freeze-ups. No doubt or uncertainty.

★ Won't evaporate

One filling of G. P. A. lasts all winter. It won't evaporate—not even on the warmest day. It's safe to fill EARLY!

★ Stays put—causes no leakage

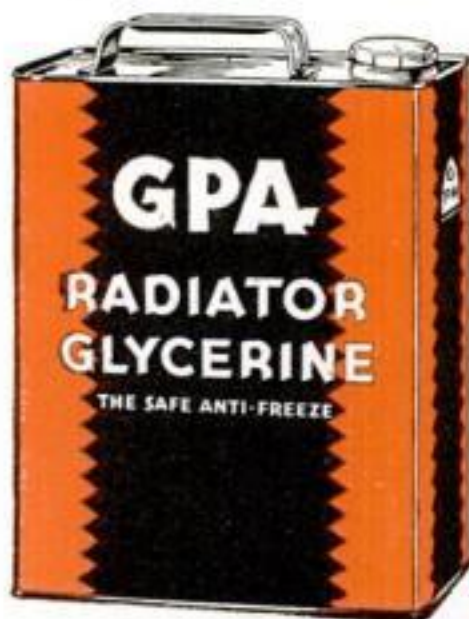
G. P. A. will stay put in any radiator that is water-tight. Flush out the cooling system, check it for leaks, and fill her up. Be sure you get enough G. P. A. to protect to the lowest temperature.

★ Stops rusting and corrosion

G. P. A. stops the corrosion of *all* metals in the cooling system. It also retards the disintegration of rubber hose.

★ Will not clog or gum

The new G. P. A. in no way interferes with the efficiency of the motor. Doesn't cause overheating. Won't clog or gum.



Forget about your thermometer! Get that worried look off your face! Life's too short to bother with fickle, fade-away anti-freezes that vanish whenever the weather or the motor gets a little too warm.

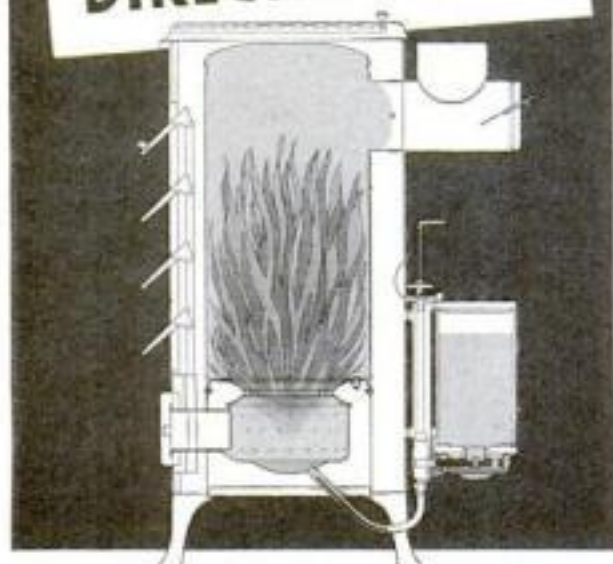
No need worrying this year—not with G. P. A. Radiator Glycerine prices so low! G. P. A. won't evaporate no matter how warm the weather. One filling lasts all winter. No refillings required. And G. P. A. prices are DOWN. Lowest in G. P. A. history.

Read the advantages listed at the left. Remember, too, that G. P. A. has no unpleasant odors; that it won't injure Duco.

Stop at the nearest garage or filling station and get your G. P. A. And be sure you get *genuine* G. P. A.—in the red and black can. Glycerine Producers' Assn., 386 Fourth Ave., New York.

★ 1933's BIGGEST ANTI-FREEZE BARGAIN ★

GIVE YOUR HOME DIRECTED HEAT



Oil-burning Superfex Heat-Director stove gives new comfort and convenience

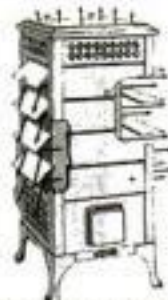
Yes, directed radiant heat! No more cold floors or drafty corners. No more ashes. Superfex Heat-Director stove offers modern oil heat to every stove-heated home.

The Heat-Director has shutter-like heat projectors which can be opened as much or as little as you please, throwing the heat rays toward floor or other surface where you want quick heat. When you want a circulating heater, close the projectors and open the top damper slide.

The fire responds instantly to a turn of the handy control valve. The modern vaporizing burner uses inexpensive fuel oil, distillate or kerosene.

See these new stoves at your dealer's. See also, the radiating type Superfex heaters in porcelain enamel or black finish. Ask for a demonstration.

SUPERFEX
Heat-Director
No. 1007



Arrows indicate direction of circulating heated air and radiant heat rays.

SUPERFEX

Oil Burning HEATING STOVES

The mark of Quality



Glowing Warmth for Cold Corners

Chase chills from cold spots with a portable Perfection heater. Firelight models have transparent globes of Pyrex brand glass. Others, all metal in choice of finishes. Prices as low as \$5.95 (slightly higher in the South, the far West and in Canada).

SEND THE COUPON

PERFECTION STOVE COMPANY

7704-C Platt Ave., Cleveland, O.

Please send me additional information about:

☐ SUPERFEX Heating Stoves

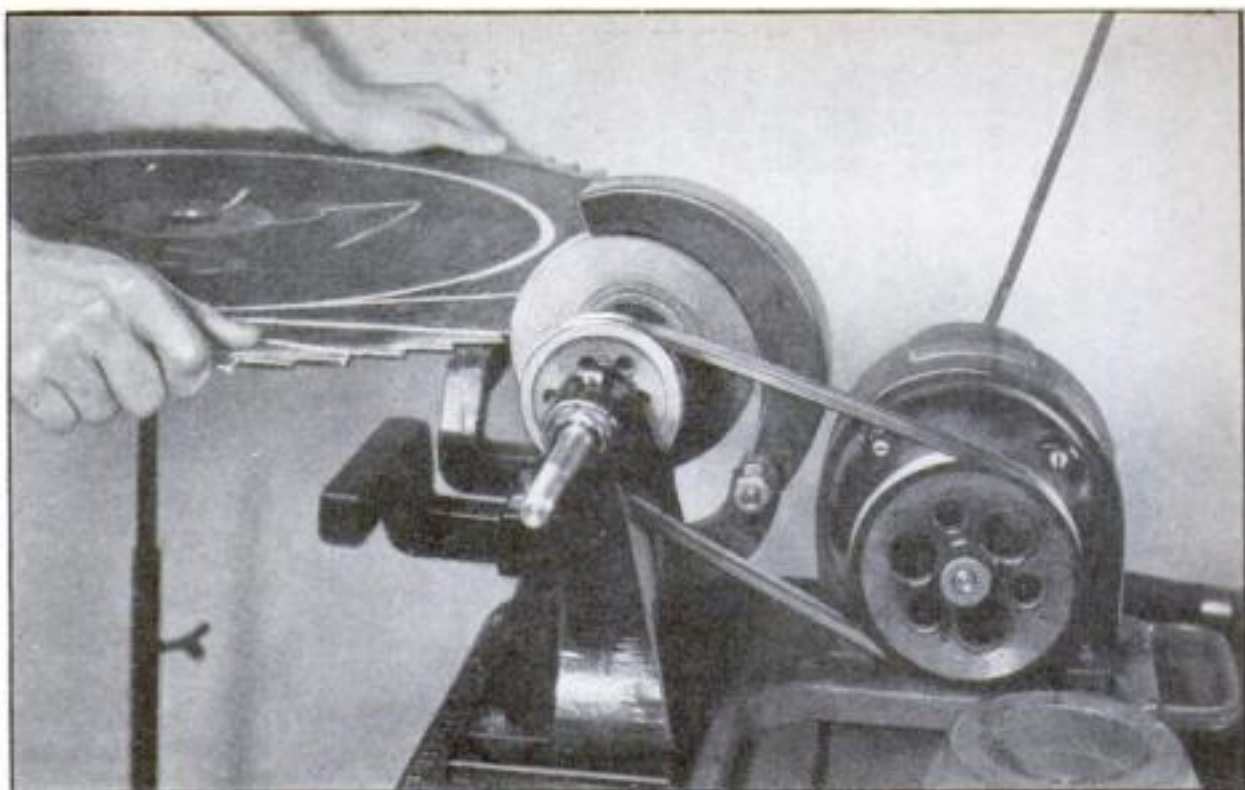
☐ PERFECTION Portable Kerosene Room Heaters

Name _____

St. or R. F. D. _____

Post Office _____

State _____



HOW TO GUM TEETH OF CORDWOOD SAW

GUMMING a cordwood saw can be done by farmers who have a power grinder. The work consists in grinding out the throat of each tooth to make large, round gullets of a uniform depth. These prevent the saw from binding and cracking.

Saw-gumming wheels that are $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ in. thick and 6 or 8 in. in diameter are used for this work. The thickness of gummer required is determined by the saw at hand. The $\frac{3}{8}$ by 6 in. size is suitable for most farm saws.

A stand or support needs to be placed under the saw at the same height as the top of the tool rest of the grinder so that the saw may be pressed straight against the gummer and so that the edge of the gullet will be square to the side of the saw. A slanting edge would cause sawdust to be wedged against the side of the saw kerf and the saw would bind.

The shape of the teeth of a cordwood saw is shown at A. The fronts of the teeth pitch to the center of the saw. The saw is placed on the stand and tool rest in such a position that the gumming wheel aims tangent to a circle which is about one third from the rim to the center. A circle may be drawn with a piece of chalk as shown in the photograph above, and lines ruled from the points of the teeth tan-

gent to the circle to serve as guides.

The teeth shown at B, improperly shaped and filed, are typical of those found on farms. Keep in mind the shape of the teeth, as shown by the dotted line C. An outline of the teeth made with chalk on the saw is helpful.

The gumming process may be started at D so as to produce the correct shape for the back of tooth E. In many instances the front of the tooth needs to have considerable metal removed to give it the correct shape. Much of this may be removed with the gummer as at F. To give the right "hook" to the front of a tooth, the gummer is aimed toward the center of the saw. To prevent overheating the steel, hold the saw lightly against the gummer and move from one gullet to another frequently. The surface of the

gumming wheel needs to be cleaned off and kept to the desired shape with an emery dresser. If much gumming is done on one gullet at one time, the saw blade may become heated sufficiently to caseharden the steel.

In filing the teeth, only enough metal is filed from the front of a tooth to give it the correct shape and to bring it to a point. Filing is then done on the back of the tooth to give it the shape shown in the drawing at G.—L. M. ROEHL.



Diagrams showing how the saw-gumming wheel is used to grind the teeth to the correct shape



WATERPROOFING PAPER

ONE of the most effective methods of waterproofing paper known, and one for which the ingredients may be purchased at the corner drug store, is as follows: A solution of caoutchouc is prepared. This is India rubber dissolved in caoutchicin (oil of caoutchouc), which is an oily, volatile liquid easily obtainable. The unsized paper, free from grease and dirt, is placed in this solution for a few seconds. It is then hung up to dry.—L. A. L.

The Secrets of Chemistry

made easy for everyone



No. 3 1/2—This set comes in a fine wooden cabinet and contains 41 chemicals and pieces of apparatus. More than 265 scientific experiments are given in the Manual of Instruction. Chemical tables and instructive information is printed on the inside of the lid. Price \$3.50

CHEMISTRY is full of interesting secrets and surprises that will fascinate you . . . and a CHEMCRAFT outfit is the best and easiest introduction. You can work hundreds of practical experiments and astonishing tricks of chemical magic; make many chemical products, test all kinds of things and learn their chemical contents, and produce changes and reactions that will show you interesting facts and give you much valuable information on Chemical Science.

CHEMCRAFT gives reliable information because these outfits are scientifically accurate; designed by chemists, used in schools and colleges and endorsed by teachers and professors. They cover all branches of chemistry and hundreds of subjects are explained and demonstrated by actual experiments. A CHEMCRAFT outfit will help any student in science and chemistry, and provide a sound foundation for more intensive future study.

REGISTERED TRADE MARK
CHEMCRAFT
THE CHEMICAL OUTFIT

—the most Complete and Practical Outfits for Home Experimenters!

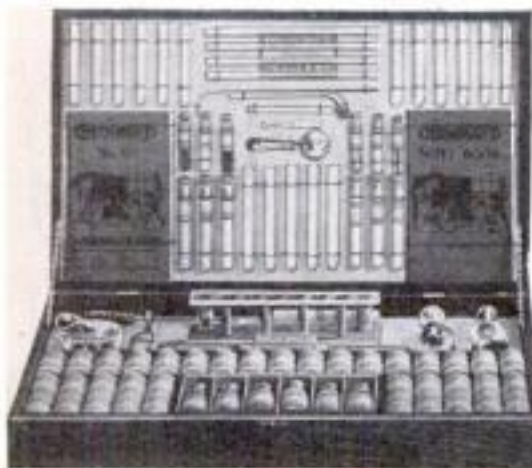
Each CHEMCRAFT outfit contains a liberal assortment of non-poisonous chemicals, all necessary apparatus and a Manual of Instruction. Quantities of chemicals permit each experiment to be repeated many times. CHEMCRAFT is the original chemistry outfit; these sets offer more and better experiments, superior apparatus and chemicals, and greater value in every way. All experiments are based on scientific research and only accurate, reliable information is included.



This is CHEMCRAFT No. 1—a useful set containing 20 chemicals and pieces of apparatus for working 127 experiments and tricks. Price \$1.00



No. 10—(Below) This complete set contains 105 different chemicals and pieces of apparatus, including many rare and costly chemicals and special apparatus, all packed in a large, mahogany-finished wooden cabinet. More than 500 experiments and tricks are explained in the Manual of Instruction. Price \$10.00



No. 5—(Above) Here is a practical chemical laboratory packed in a mahogany-finished wooden cabinet. This set contains 68 chemicals and pieces of apparatus, including a large test tube rack. The Manual of Instruction explains more than 360 experiments and tricks, and a Note Book is included for keeping records of experiments. Price \$5.00

No. 15—A Practical Chemical Laboratory! This big set contains 122 chemicals and pieces of apparatus, with which more than 640 scientific experiments can be performed. Comes in a large, mahogany-finished wooden cabinet. Price \$15.00

Nine Sizes to Select From:

No. 0 — 8.50	No. 3 1/2 — 83.50	No. 10 — \$10.00
No. 1 — 1.00	No. 5 — 5.00	No. 15 — 15.00
No. 2 — 2.00	No. 8 — 8.00	No. 25 — 25.00

(Nos. 1, 3 1/2, 5, 10 and 15 are illustrated here)

(No. 8 is a Portable outfit in a compact carrying case, and No. 25 is a complete home laboratory)

* Get a CHEMCRAFT outfit this Christmas! Look for these outfits in hardware, department and sporting goods stores, and wherever good toys are sold. Be sure the name CHEMCRAFT is on the box. If the size you want is unobtainable, we will send it, fully prepaid, upon receipt of price.

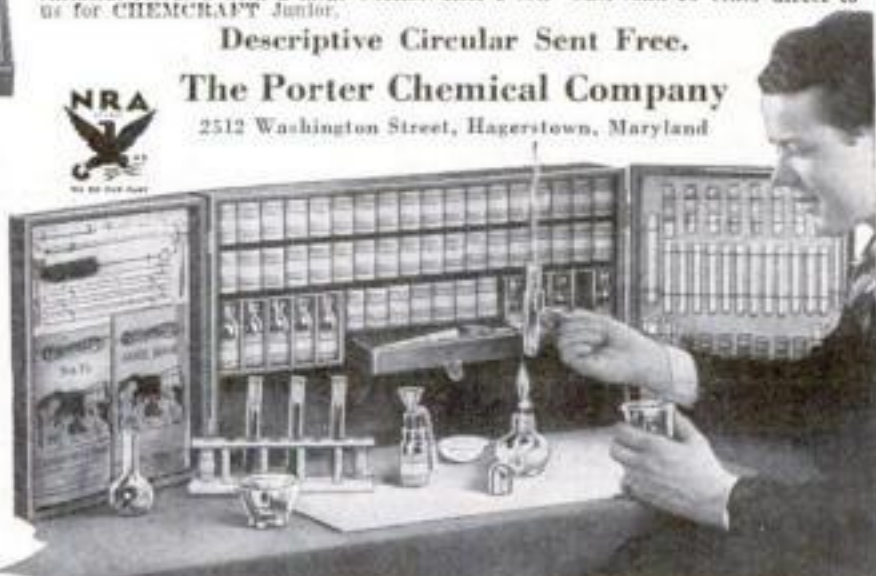
Send 10c for CHEMCRAFT Junior

Try Chemistry with CHEMCRAFT Junior; you can perform many fine experiments and tricks with this outfit. It will introduce you to the fascination of chemical research with a large CHEMCRAFT set. Just send 10 cents direct to us for CHEMCRAFT Junior.

Descriptive Circular Sent Free.

The Porter Chemical Company

2512 Washington Street, Hagerstown, Maryland





NO GUESSWORK

Look for this approval tag on the sunlamp and the monogram on the bulb

How much sunlight in a sunlamp?

UNDER the recommended NRA Code, portable sunlamps will now bear tags rating them A, B, C, D, or E according to ultra-violet output (A being the highest). If the portable sunlamp you buy is rated A or B, and if the GE monogram appears on the bulb, you can be certain of adequate ultra-violet!

Portable sunlamps using General Electric MAZDA Sunlight Lamps (bulbs), Type S-1 or Type S-2, are rated A or B respectively. These MAZDA Sunlight Lamps have been accepted by the Council on Physical Therapy of the American Medical Association and by the American College of Surgeons. The S-1 at 60 inches and the S-2 at 20 inches give you the ultra-violet intensity of midday midsummersunlight.

FREE BOOKLET TELLS THE STORY

Mail coupon now for your free copy of "The Indoor Sun." It tells the story of ultra-violet, explains the new portable sunlamp ratings, and gives names of manufacturers.



GENERAL ELECTRIC, Dept. 166, Nela Park, PS 12
Cleveland, O.

Please send me free copy of "The Indoor Sun."

Name _____

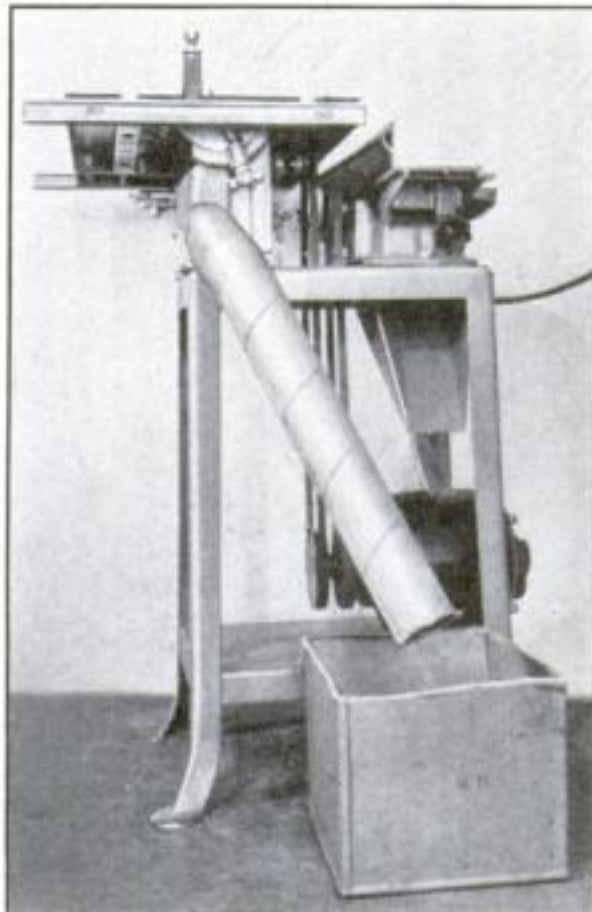
Address _____

GENERAL  ELECTRIC

CARDBOARD TUBE USED FOR SAWDUST CHUTE

IF YOUR circular saw does not have a sawdust collector of some kind, a chute made from a strong cardboard tube not less than 3 in. in diameter may be used to direct the sawdust into a box. In the installation illustrated, this is the same box in which the planer shavings are collected.

The tube should be about 1/8 in. thick. The bend is made by mitering the tube and joining



Sawdust is discharged through the tube into the same box used to catch planer shavings

with gummed paper or surgical tape. If several layers are applied alternately across and around the joint, a surprisingly strong joint will be obtained. The upper end of the tube is cut to fit around the sawdust nozzle on the machine. As the saw illustrated has a bead around the discharge opening, the tube was fastened to it by wrapping a piece of baling wire around the tube above the bead and twisting it tightly with the pliers. In other installations it may be more convenient to use a C-clamp.—DONALD A. PRICE.

QUICK-ACTING HOLDER FOR RUBBER BANDS

RUBBER bands can be quickly snapped around small packages with the aid of the holder illustrated. It is simply a piece of wire bent into the shape shown and with the ends inserted in holes drilled in a suitable wooden base. The dimensions depend upon the bands used and the size of the packages, but 3 in. across the top is sufficient for ordinary purposes. This particular holder has a capacity of 100 bands. The package is placed on the top bar, and the rubber band is drawn up over it. The band automatically stretches to the proper width and snaps around the package without further handling.—DANIEL REYNOLDS.



HE IS A "keen fellow"



TYPICAL of some men found throughout all industries, this man is known for his clear incisive thinking—for the keenness of his mind which cuts away the non-essentials when planning is to be done on a job.

The quality of keenness is also a necessity in files. Nicholson Files have this quality to an unusual degree, making it easy for them to cut down the time required for filing.

Nicholson Files owe their keenness to the best file steel, careful shaping, scientific cutting of teeth, expert tempering and finishing and the most rigid testing through every stage of manufacture. Working in industrial plants, home workshops, Nicholson Files, because of their keenness can and will demonstrate their superiority. Let them do this for you.

At hardware and mill supply dealers'. Nicholson File Company, Providence, R. I., U. S. A.



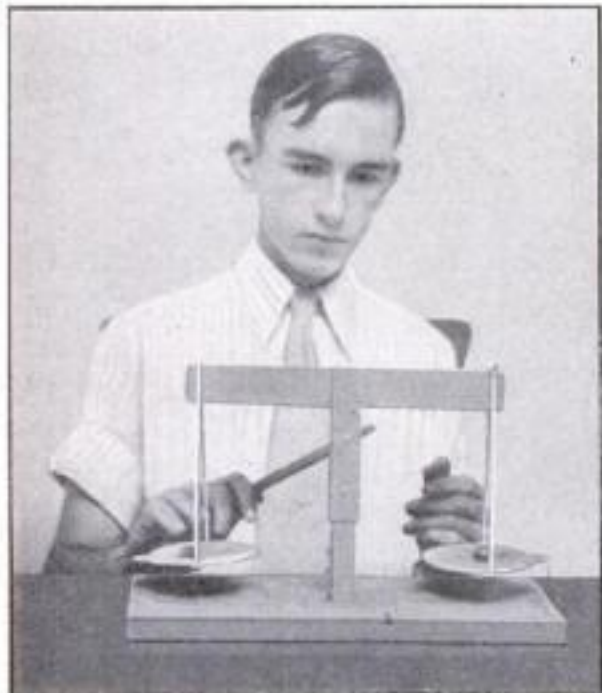
NICHOLSON FILES

A FILE FOR EVERY PURPOSE

MAKING SET OF WEIGHTS FOR A BALANCE

A SET of weights sufficiently accurate for a balance used for home chemical experiments and photographic purposes can be made with little difficulty. The balance I use was made from instructions published in a previous issue (P.S.M., May '32, p. 106). For the metric system at least four weights are required for a balance of this type—two 10-gram, a 20-gram, and a 50-gram. A 100-gram weight is also useful.

Obtain a 10-gram weight or two United States 5-cent pieces, as a nickel weighs 5



By methodically balancing weights against each other, a complete set may be prepared

grams when minted. Place them in the left-hand pan of the balance and move the slider to the extreme right end of the slider arm. Be sure to leave the slider in this position while making the weights. Balance the scales by filing the slider, if too heavy, or by adding solder to it, if too light. Remove the weight from the pan and set it aside, as it will not be needed again. Place a piece of brass or lead in the left-hand pan and trim it to balance the scales, making a 10-gram weight. As two of these weights are needed, balance the scales again with another piece of brass or lead.

If lead is used, it may be melted and cast in a $\frac{3}{4}$ by 6 in. test tube if a little lard or oil is added to prevent the lead from adhering to the walls when cold. The grease will not mix with the lead and can easily be scrubbed from the casting when it is removed from the tube.

Take one of these 10-gram weights, place it in the right-hand pan, and balance as before, making a 20-gram weight. Place the two 10-gram and the one 20-gram weights in the right-hand pan and balance the scales, making a 50-gram weight. A 100-gram weight can be made by adding the 50-gram weight to the rest of the weights in the right-hand pan and balancing as before.

It is essential that the slider be left on the right end of the slider arm while making the weights and that the weights be trimmed to balance the scales exactly. In weighing, always put the substance to be weighed in the left-hand pan and the weights in the right-hand pan.—SMITH HARRIS, JR.

TO RECEIVE ATTENTION, every inquiry relating to articles published in POPULAR SCIENCE MONTHLY must be accompanied by a self-addressed, stamped envelope. It is important that the questions be brief and to the point. Mention the article, the page, and the issue of the magazine to which reference is being made.

Scientists Create Sensational Monster



Giant Pre-Historic Ape that Growls and Moves with Spine-Tingling Reality Scores Hit at Chicago Fair

Creators of This Mammoth Say Plastic Wood Played Important Role in its Making

In a great New York studio a group of artists created the pre-historic mammoths that make "The World a Million Years Ago" one of the most popular exhibits at the Chicago Fair. It took a lot of ingenuity and plenty of Plastic Wood to make these realistic monsters. Craftsmen have found Plastic Wood indispensable in achieving perfection in their work.

There's nothing known to science that is better for modeling, pattern-making and for making repairs around the house.

Plastic Wood is easy to use . . . handles like soft putty. Then it quickly hardens into wood—water-proof, weather-proof, lasting wood that can be sawed, planed, filed and sanded.

Wood that takes and holds nails and screws every bit as good as natural wood. Wood you can paint and varnish. Buy a can or tube of Plastic Wood at any paint or hardware store—choice of nine colors. Try it. YOU'LL SAY IT'S WONDERFUL.

Hand-Book of Uses FREE

There are hundreds of uses for Plastic Wood. Facts and pictures showing more than two hundred of them, from fixing a broken chair leg to making patterns and ship models, are now in an interesting HAND-BOOK which will be sent you FREE. Just fill in and mail coupon for it . . . today.



The A. S. Boyle Co.
Dept. PS-12, Cincinnati, Ohio

Send me FREE—big book of uses for PLASTIC WOOD.

Name.....

Street & No.....

City.....State.....

This BIG STEAM ENGINE Given



Here's your chance to get this husky, smooth-running steam engine. Look at the picture. Isn't it a beauty? Manufactured by world's leading maker. Fine quality and highly finished in bright colors. Has fly wheel, smooth-running piston, and sturdy cylinder. Strong boiler and fittings, pulley wheel that runs mechanical toys. Boiler heated by an electric unit. All that is necessary is to connect it to an ordinary house lighting circuit with a standard plug. Big, powerful, a real beauty you will be proud to own. Just what you have been waiting for and you can have it **FREE!** Read Special Offer.



Smashing Adventure Tales

The Open Road for Boys is a 50-page magazine publishing sparkling stories of air adventure, sport stories, articles by famous coaches

and star athletes; adventure stories of the barren wastes of the Arctic, of the wild jungles of the Tropics, of the battlefields of the World War, of the cow towns of the Old West, and of the mysterious lands of the Far East; business stories, school stories, and many others. In addition four great serials, each worth \$2.00 in book form. Worldwide correspondence club, stamps, Open Road Pioneer Club, best dope on hunting, fishing, camping. Contests galore, with plenty of prize money. Red-blooded stories for red-blooded boys.

SPECIAL OFFER

To make new friends, we will send you the next twelve fat issues of The Open Road for Boys for \$1.00 and send you also this BIG steam engine **FREE!** Act quickly!

FIRE LIEUT.

The Open Road For Boys
130 Newbury St., Boston, Mass.

Sure I want the Big Steam Engine. Here's my \$1. Shoot it along quickly and send me The Open Road one year.

Name

Street

City State

No orders sent outside
The United States

Constructing this Upholstered Stool

will give the beginner practice
in laying out mortise and tenon
joints for parts set at an angle

By Herman Hjorth

Author of *Basic Woodworking Processes*
and *Principles of Woodworking*



Hair is the best stuffing, but
moss or tow may be substituted

THE upholstered stool shown below may serve as a foot rest for a person reclining in an easy chair or it may be used by a child to sit on.

Start with the legs. As each of these have two square parts to which the rails and stretchers are joined, it is necessary to square the legs to dimensions before beginning the turning. It is preferable to plane one piece long enough for the four legs rather than cut four short pieces. The legs should be about $\frac{1}{2}$ in. longer than needed so that the marks left by the lathe centers can be cut off. Place them side by side on the workbench and square lines on all four where the square parts are to be. Center each piece carefully in the lathe and make a little saw cut on the corners where the lines have been drawn. This will make the turning easier in that it will prevent chipping the square corners. Instead of being turned, the legs may be shaped on the edges as shown in the alternate detail.

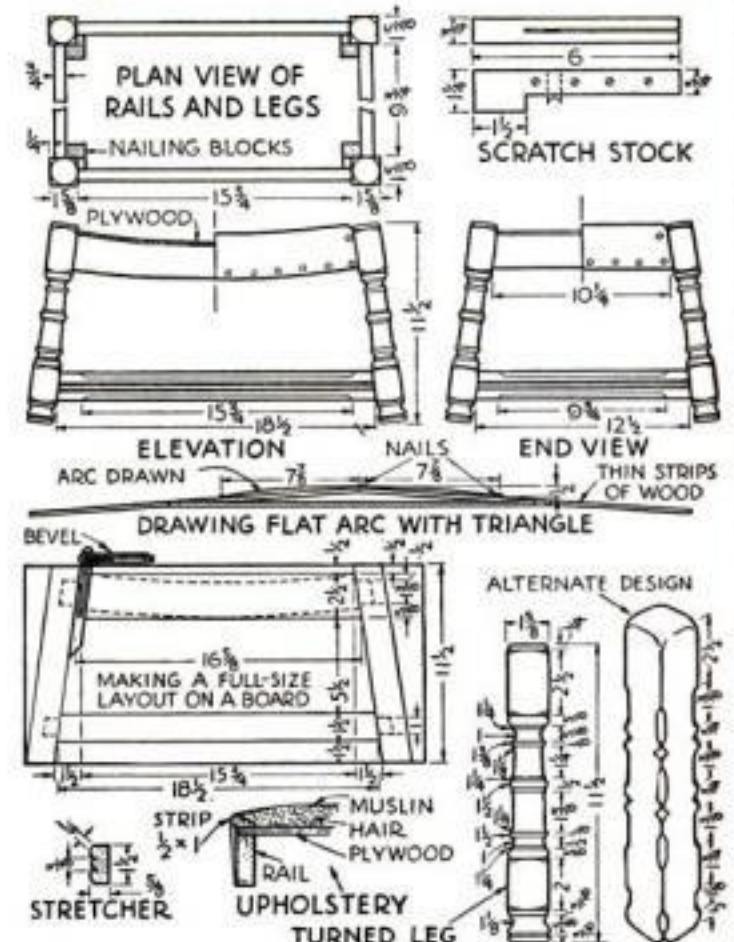
After the legs have been turned, it is necessary to make a full-size layout of the side and the end in order to obtain the correct angle of the cuts and the exact length of the pieces. The rails and stretchers are then cut and planed to size. The side rails should be left with straight edges until the mortise and tenon joints have been made. Similarly, no chamfers or beads should be cut on the stretchers until after the mortising has been completed.

The mortise and tenon joints are laid out in the regular way except that the shoulder cuts on the tenons are marked with a sliding T-bevel set to the correct angle as shown on the layout drawing. The tenons on the rails should be $\frac{3}{8}$ in. thick and the tenons on the stretchers $\frac{5}{16}$ in. thick. The rails and stretchers should be set in $\frac{1}{4}$ in. from the face of the legs. Fit each mortise and tenon joint and number the parts. Then fit each side and each end

together and see that they correspond in size.

The chamfers and beads are now cut on the stretchers. The chamfers are laid out with a pencil and worked out with chisel and block plane. The beads are cut with a homemade tool called a scratch stock. It consists of a piece of hardwood of the approximate dimensions shown on the

drawing. A cutter, filed to shape from an old saw blade, is inserted in the saw cut and held in place with screws. This tool is also



A finished footstool, assembly and detail drawings, an alternative leg, and a scratch stock for beading

useful in making small moldings from close-grained hardwood when suitable stock moldings are not available for any project.

The arcs on the side rails have such a long radius that they are difficult to lay out. An easier way is to drive three nails into a board as shown. Make a triangle of three pieces of thin wood nailed together so that its apex is at the center nail and its sides touching the other two nails. Hold a pencil at the apex and move the triangle from side to side, and an arc of the correct curvature will be drawn.

Sand the legs in the lathe and cut them to correct length. Then glue the two ends. Each end is clamped with two bar clamps. Wedge-shaped blocks are placed between the clamps and the legs to protect the surface of the wood. When the ends are dry, they are glued together with the other two rails and stretchers.

Before the upholstering is done, the stool should be sanded and given a coat of stain.

List of Materials

No. of Pieces	Description	T.	W.	L.
4	Legs	1 3/8	1 3/8	11 1/2
2	Side rails	3/4	2 1/2	18 1/4
2	End rails	3/4	2	12
2	Side stretchers	5/8	1 1/2	20
2	End stretchers	5/8	1 1/2	14
1	Seat bottom, plywood	1/4	12 1/2	18 1/2
1	Strip for edge	1/2	1	51

NOTE: Dimensions are given in inches. These are finished sizes.

It is then prepared for the upholstery by fitting a piece of 1/8- or 3/16-in. plywood around the legs and nailing it to the upper edge of the rails. The plywood is made flush with the outside face of the rails. A strip of wood 1/2 by 1 in. is then planed to shape as shown on the upholstery drawing and nailed or screwed over the plywood to the rails. Let it project 1/4 in. over the sides. This forms the edge of the seat and gives it the proper shape.

It is best to use hair for the stuffing, but moss or tow may be substituted. Pick all the lumps out of the hair and spread it in an even layer over the seat. It may be held in place either by driving some tacks through it into the plywood or by brushing some glue on the plywood before spreading the hair. Another layer of hair is then placed evenly on top of the first and a piece of muslin stretched over it and tacked to the lower edge of the rails. It is also tacked in the corners around the legs to blocks previously nailed to the legs.

The stool may now be given three coats of a good rubbing varnish. Varnishing should always be done in a dust-free, warm room. Rub the first and second coats with No. 2/0 or 3/0 steel wool and wipe off with a rag moistened in turpentine. Rub the last coat with a felt pad, powdered pumice stone, and crude oil. The turned part may be rubbed with a piece of waste or with a brush having close, stiff bristles.

The covering is now nailed over the muslin. A piece of cotton wadding should first be placed over the muslin to make a more even surface. The edges may be trimmed with a narrow gimp or band of the same or similar material as the covering. Fancy brass nails or gimp tacks are used to fasten this trimming.

...

When ordering back issues of POPULAR SCIENCE MONTHLY, please send 25 cents for each issue except the current one and the three issues immediately preceding. These four issues are only 15 cents each.

RADIO TOURS

LET'S GO PLACES AND HEAR THINGS!

Replace weak, limping tubes with tubes made by RCA—and come on along!

DON'T be a stay-at-home...limited to the few stations near at hand! Come on a Radio Tour! Get the thrill of a "first night" in Hollywood...the Hill Billy "Shindig" in Asheville...those German comedians in Milwaukee...the "Tent Show" in Des Moines...your own college football game back home... "The Kingfish" speaking in Louisiana... Rhumba players down in Havana. A million dollars worth of radio entertainment is waiting for you... Go places, hear things! With new, powerful tubes, with a good radio set thoroughly in order you can bring in stations beyond the reach of tubes that are worn and old.



Step into the heart of Chicago, hear the famous programs from the loop—on a Radio Tour!



A million dollars worth of radio talent—yours on a radio Tour!

Have your dealer test your tubes

To go on a great radio tour every night—your ticket is simply a good radio set plus a new set of Cunningham Radio Tubes or RCA Radiotrons to replace weak and limping tubes. Only RCA Radiotrons and Cunningham Radio Tubes are actually *made* and *guaranteed* by RCA. Built to give you full, complete tone, wide range, sure performance and long life.

A remarkable free booklet, "Radio Tours" tells you whether your set is giving you all it should. It lists all stations in the U. S., Canada, Mexico; it provides a "radio yardstick" and a map that shows your own locality and all the stations you *should* get. Ask your nearest dealer for "Radio Tours"—or mail the coupon below.



Broadway and the great White Way. The heart of the show business...go there on a Radio Tour!



San Francisco's Chinatown...all the entertainment of the Golden West—on a Radio Tour!



Cunningham Radiotron

Without any obligation please send me your illustrated folder "Radio Tours" with station map and "radio yardstick." I am enclosing 10c in stamps for postage and handling.

Name

Address

(Coupon must be sent to RCA Radiotron Co., Camden, N. J.) 15



SEND
FOR

free

TRIAL PACKAGE

CASCO
WATERPROOF
GLUE

It will work wonders for you as it has for thousands of other Popular Science readers. Things that would not stay glued before...now you can put them together **permanently**, in spite of moisture, heat, rough usage or plain neglect.

New Easy Method of Building and Repairing Things

Home craftsmen and amateur mechanics everywhere are discovering how CASCO Waterproof Glue, the wonder-working adhesive, makes it possible to glue things easily, quickly and **permanently**...just as is done in big woodworking and furniture factories.

And they are amazed and intrigued to find that CASCO...a clean non-odorous powder...is mixed so quickly with cold water into a creamy, easy-spreading, quick-setting glue of unequalled strength.

Unlike ordinary glues and pastes which harden merely through evaporation, CASCO SETS CHEMICALLY LIKE CONCRETE. Articles glued with CASCO stay glued.

CONVINCE YOURSELF

Take your free sample and prove CASCO'S quality. The free sample you receive will contain enough CASCO to do a test job and prove CASCO'S superiority. In larger quantities CASCO may be obtained from your Hardware, Paint or Building Supply Dealer. 1/2 lb. can 40c; 1 lb. can 65c; also 5 lb. and 10 lb. moisture-proof bags.



GOOD FOR FREE PACKAGE

THE CASEIN MFG. CO. OF AMERICA, INC.
207 East 42nd Street, New York, N.Y.

Please send me, absolutely Free, a sample of CASCO Waterproof GLUE.

Name _____

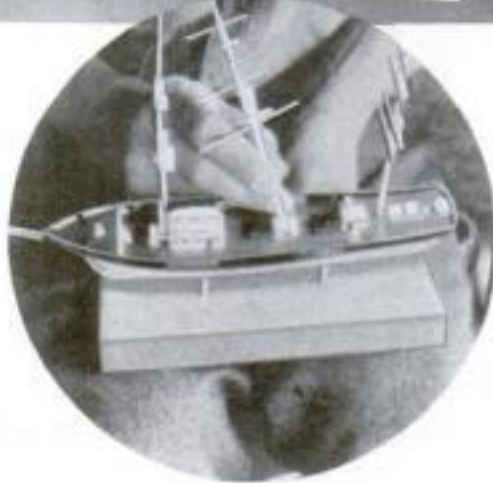
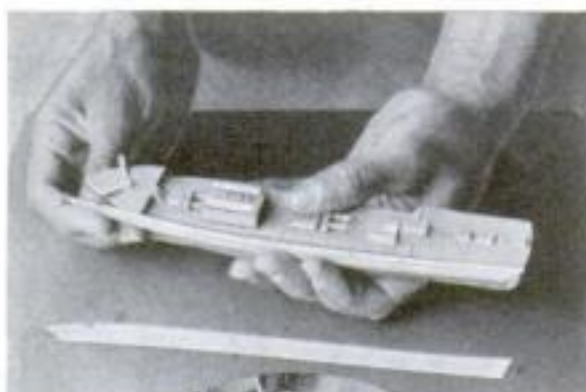
Street _____

City _____ State _____

(P.S.M. 12-33)

CLIPPER SHIP MODEL

(Continued from page 67)



Holding a bulwark in place until the glue sets, and erecting the assembled mainmast

with the simplification of the previous models of boats and planes described in this series.

The anchor will look realistic if it is made of fine wire such as is used for making artificial flowers, twisted and glued as shown in one of the sketches. Several wrappings will be needed to get the right thickness. A bit of match stick will serve for the stock or crossbar. Paint the anchor black. Two can be made if desired. The anchor chain and the bobstays can be represented with small chain of the kind used for restringing beads. This can be obtained in the ten-cent stores.

Having completed the work thus far, you are ready to paint your model, which should be done before the rigging goes on. Varnish the decks and the upper masts. Give the remainder of (Continued on page 83)

List of Materials

Dimensions	No. Pc.	Material
1 9/16 x 1 3/4 x 9 1/2	1	White pine for A
3/8 x 7/8 x 2 1/2	1	White pine for G and K
3/16 x 9/16 x 3 1/2	1	White pine for boats, J, and N
3/8 x 3/4 x 8	1	White pine for keel, stem, rudder, T, E, F, H, I, L, and M
1/8 dia. x 3 1/2	16	Lollypop sticks (or applicators) for masts, yards, and bowsprit
1/32 x 1 5/8 x 11	1	Cardboard for bulwarks, stern piece, mast caps, ladders, channels, wheel and details
1/32 x 1 1/2 x 3	1	Fiber for cross-trees, tops, and bowsprit cap
13 yds. thin black cord for shrouds, backstays, etc.; black thread No. 70; tan thread No. 70; small chain (type used for restringing beads); fine wire, large size match sticks, safety match sticks, casein glue and household cement; thin paper for flags; varnish, and paint or enamel in black, white, red, copper, and mahogany color; small beads.		

AN AMATEUR did the inlaying on this table top IN 4 HOURS



Wouldn't you like to do work like this? It is simple with the new Stanley Electric Router-Shaper.

Made for home workshops, this new Router-Shaper is a high grade machine at a reasonable cost. With it you can do as beautiful work as the finest furniture factory.

Several exclusive and patented features of this new machine add greatly to its variety of uses. For instance the patent tilting spindle with only four shapes of cutters will produce over six hundred different decorative cuts.

Send for full description and prices.

THE STANLEY ELECTRIC TOOL COMPANY

103 Elm Street • New Britain, Conn.



The new Stanley Router Shaper is described in this catalog. Send for a copy.



Made by the Makers of the World Famous STANLEY TOOLS

Change Attachments INSTANTLY



Carve, Drill, Grind Disc, Saw, Polish Sand, Buff

Here is a superior tool built especially for the craftsman requiring accurate work. Each attachment is mounted on a separate mandrel for perfect alignment. To change attachments, merely loosen handwheel and slip into draw-in collet. Built to last a LIFETIME. Satisfaction GUARANTEED or money refunded.

We will send this \$7 Master Bench Head outfit POST PAID for \$3.95 when cash accompanies order or send \$1—pay balance C. O. D. We will include FREE one 4" x 1/2" all-purpose grinding wheel, one 4" buff and our step-up 1/2" mandrel. Write for booklet on other special attachments and craftsman's letter.

WISCONSIN ABRASIVE COMPANY
8529 Dr., Station A, Milwaukee, Wis.

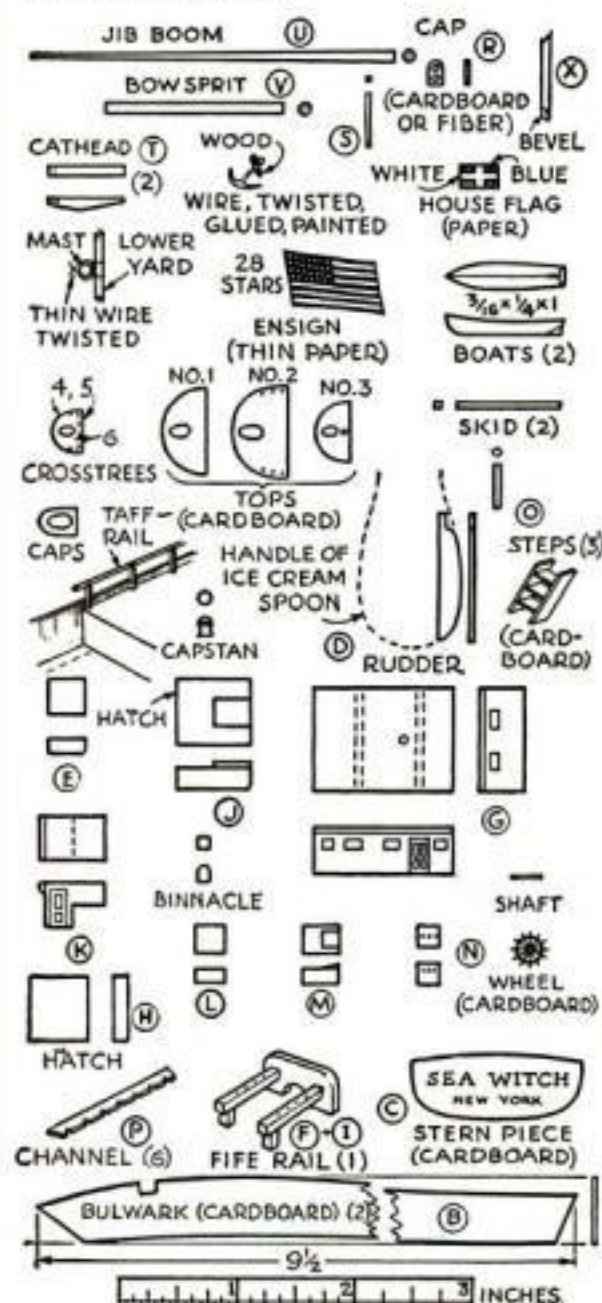
CLIPPER SHIP MODEL

(Continued from page 82)

the ship a coat of flat white. Paint the bottom of the hull up to the water line copper colored. Paint the upper part of the hull black, and when dry add a red and white ribbon stripe at the deck level. Make the bowsprit black, also the yards, windows, doorways, and tips of masts, gaff, and boom. Paint the catheads and hatches E, H and J black, but use white on the deck houses, skylight L, parts M, N, the binnacle, and the capstan. The lowermasts and doublings should be white. Use mahogany on the gaff and boom and for trimming the deck houses. Paint the name on both sides of the bow and on the stern with white. Four-hour enamel is well suited for this work.

To rig this little ship you will need at least 13 yards of thin black cord for the shrouds, backstays, and the like; also several yards of black thread and tan thread No. 70. The tan is for the running gear. Small beads will do to represent deadeyes and can be glued in place on the thread. Lines can be secured to their points by tying or, in some cases, by gluing.

One of the photos on page 82 shows how to mount the boat while the assembling and rigging are being done. The holes for the dowels should be drilled into the hull at one side of the keel.



Details of all the small parts with an inch scale. The taffrail is not an essential fitting

A SOLDERING COPPER HINT

AFTER a soldering copper has been used for some time, the point becomes pitted and cannot be tinned evenly. This can be remedied by heating the copper to a cherry red and hammering the point out to the desired shape, reheating as necessary.—BASYLE PALMER.

New Circular Saw Has 7 Big Features

U. S. Patents
No. 1,697,669 No. 1,902,270
No. 1,894,010 No. 1,910,651
No. 1,896,924 Others Pending



A production quality tool for home work shop or factory—priced within the reach of all!

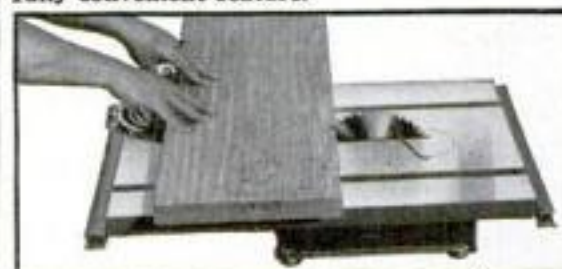


Front Extension provides room where it is most needed—the real zone of service.

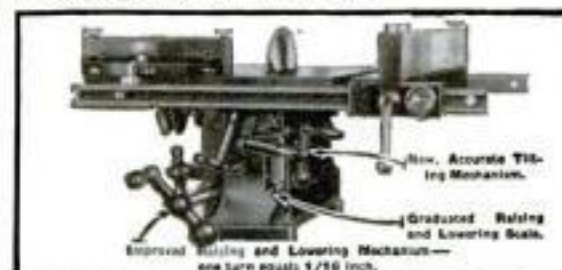
New "Delta" Saw with Side and Front Extensions in use.



New patented extensions provide all the advantages of a table 4 feet square at a fraction of the cost of a very large table—a wonderfully convenient feature.



Front table extension gives ample room in front of saw blade where it is most needed. Another convenient feature.



A few more of the many convenient features found in the New 1934 "Delta" Circular Saw.

10-Day Trial Easy Terms!

Because "Delta" Tools are efficient and practical under actual working conditions they are always available for a 10-day trial without the slightest risk. Satisfaction guaranteed. Mail the coupon for full details of this liberal trial offer.

DELTA MFG. CO., 3775 North Holton Street
Dept. B1233, Milwaukee, Wisconsin

Revolutionizes All Types of Circular Saw Work

The new 1934 "Delta" Circular Saw offers a number of exclusive revolutionary features, among which are: 1. Enormous Capacity in front of saw where it is needed most; 2. All the advantages of a Large Table at a fraction of the cost; 3. Patented automatically-set Miter Gauge, the most convenient miter gauge available; 4. Special Miter Gauge Clamp Attachment which insures accuracy; 5. Micrometer Self-Aligning Rip Gauge; 6. Patented Trunnion Construction, which has numerous advantages; 7. Numerous important constructional advantages that make for longer service and added efficiency. For the full story of this remarkable tool, send the coupon below.

A Complete Line of Modern Motor-Driven Tools



"Delta" Scroll Saw—Revolutionizes Scroll Saw work. Runs at full motor speed (1800 strokes per minute) with no vibration. Smooth-cutting—it has many novel features.

"Delta" Woodworking Units are convenient, portable and compact. All are available in a large variety of combinations and at prices to fit all needs. The complete "Delta" line includes Jointers, Band Saws, Circular Saws, Scroll Saws, Drill Presses, Wood-turning Lathes, Boring, Routing, Sanding, and Mortising Attachments—and a full line of accessories.



"Delta" Drill Press—6 tools in one! Can be used for Shaping, Boring, Mortising, Routing, Sanding and Carving.

FREE Catalog

Describes the latest developments in motor-driven woodworking equipment at the astonishingly low "Delta" price levels. Fill in and mail the coupon below—NOW!

DELTA MFG. CO., 3775 North Holton Street
Dept. B1233, Milwaukee, Wisconsin

Please place me, without obligation, on mailing list to receive the Free 1934 "Delta" Catalog of Quality Woodworking Tools. Also send full details of your 10-day Trial Offer and Easy Payment Plans.

Name.....Age?

Address.....

City.....State.....

TAKE THE GRIEF OUT OF EMERGENCY REPAIRS

A sudden leak in the heating boiler—the hammer handle flies off—water squirts from a dent in the auto radiator—a drawer knob pulls out—screws strip from and loosen the door lock—a water pipe freezes and cracks—one caster won't stay in the table leg—your favorite pail starts to leak—a persistently loose nut puts the vacuum cleaner out of business—etc.—etc.

Possibilities like these are ever present to the householder, but invite no delays, repair bills or expensive new purchases if you have a copy of the Smooth-On Repair Instruction Book, keep a can of Smooth-On No. 1 on the shelf and like to prove yourself equal to the emergency.

Hundreds of repairs similar to the above are made quickly, easily and cheaply with Smooth-On No. 1, which stops leaks of steam, water, gas, oil, gasoline, smoke, etc., anchors loose screws, bolts, nuts, handles, machinery, etc., and holds equally well in metal, masonry, bath room tile, and wood.

Smooth-On No. 1 expands in hardening and when metallized holds as tightly as the metal to which it is attached. Power plant engineers, shop foremen and professional repair men prefer Smooth-On repairs because the simple cold application avoids fire risk and extra labor and a dependable finished job is ready in a hurry.

Get Smooth-On No. 1 in 7-oz. or 1 or 5-lb. can from any hardware store.



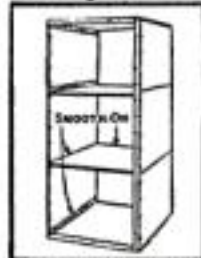
Smooth-On Radiator



Leaky Pail



Leaky Kettle



Leaky Tank



Stove Pipe



Oil Leaks

FREE

This booklet also covers automobile repairs, tells how to stop water leaks in radiators, cracked water jackets and at loose hose connections, also how to stop gasoline leaks from the tank and gasoline lines, fume leaks from the exhaust system, and oil leaks at gaskets and at cracks in crank or gear case. It also tells how to make headlight posts, nuts, hub caps and bolts and grease cups stay tight, and shows dozens of simple money saving Smooth-On repair jobs. Sent free if you return the coupon.



Write for
FREE BOOK



Do it with SMOOTH-ON

SMOOTH-ON MFG. CO., Dept. 58,
574 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book.

Name

Address

12-33

BLUEPRINTS

to aid you in your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that

there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each.

Flying Airplane Models

Bremen (Junkers, 3-ft.), 89-90.....	\$.50
Lindbergh's Monoplane, 3-ft., 69.....	.25
Nieuport XVII, 29-in., 180-181.....	.50
Rise-off-Ground Tractor, 3-ft., 50.....	.25
Seaplane, Tractor, 30-in., 87.....	.25
Seaplane, Morris (Record 12½ min.), 102.....	.25
S. E. 5a World War Plane, 30-in., 168-169.....	.50
Single Stick, Tractor, 30-in., 82.....	.25
Tractor (Record Flight 6,024 ft.), 104.....	.25
Twin Pusher, Racing, 35-in., 86.....	.25
Winnie Mae, 4-ft., 141-142-143.....	.75

Boats

Canoe, Sailing Outfit, 25.....	.25
Canoe, 16-ft. Canvas Covered Kayak, with Sail, etc., 192-193-194-R.....	1.00
With full size patterns.....	2.50
Duck Boat, Folding, 170-R.....	.50
With full size patterns.....	2.00
Outboard Racer, 11½-ft., 156 lb., 128-129-R.....	.75
With full size patterns.....	2.25
Outboard Racer, 10 ft. 4 in., 114 lb., 211-212.....	.50
With full size patterns.....	2.00
Sailboat-Motorboat, Combination (15 ft., cat rig), 131-132-133-R.....	1.00
With full size patterns.....	2.50
Marconi Rig with Jib for Above, 133A.....	.25
13-ft. Rowboat-Motorboat, 147-R.....	.50
With full size patterns.....	2.00
14½-ft. Rowboat-Motorboat, 148-R.....	.50
With full size patterns.....	2.00
16-ft. Rowboat-Motorboat, 149-R.....	.50
With full size patterns.....	2.00
Stern Drive Installation (When used with Rowboat-Motorboat), 150.....	.25
15½-ft. Runabout or "Sportboat" (outboard or inboard motor), 175-176-177-R.....	1.00
With full size patterns.....	2.50

Furniture

Bookcase, Simple, 37.....	.25
Bookshelf and Book Ends, Modernistic, 100.....	.25
Bookshelves, Hanging, 77.....	.25
Bookstand, Modernistic, 88.....	.25
Book Trough, 68.....	.25
Cedar Chest, Mahogany Trimmed, 17.....	.25
Chair, Rush-Bottom, 36.....	.25
Chests, Treasure, 78.....	.25
Child's Costume, 179A.....	.25
Clock, Grandfather, 19.....	.25
Desk, Colonial, 21.....	.25
End Table, Magazine, 68.....	.25
Fireside Bench, Colonial, 187A, 188A.....	.50
Kitchen Table Cabinet, 27.....	.25
Lamps, Modernistic, 93.....	.25
Mirror, Scroll Frame, 105.....	.25
Muffin Stand, Folding, 173A-174A.....	.75
Pier Cabinet and Corner Shelves, 77.....	.25
Radio Cabinet, Console, 70-71.....	.50
Screens, Modernistic Folding, 91.....	.25
Sewing Cabinets, Two, 31.....	.25
Shelves and Lamp, Modernistic, 93.....	.25
Smoking Cabinet, 2.....	.25
Spanish Mission Armchair, 195A.....	.25
Stand, Low Modernistic, 100.....	.25
Table, Gate-Leg, 24.....	.25
Table, Tavern, 105.....	.25
Table, Tilt-Top, Oak (Top 20 by 24 in.) 140.....	.25
Tea Wagon, 13.....	.25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, 42.....	.25
Full Electric Headphone Set, 130.....	.25
One Tube (Battery Operated), 103.....	.25
Screen-Grid Set, 109.....	.25
Short-Wave Converter Unit, 137.....	.25
Amateur Short Wave Receiver, 155.....	.25
Amateur Radio Transmitter, 183-184.....	.50
All-Wave Portable Receiver, Battery, 217-R.....	.50

Ship and Coach Models

{ Construction kits are available for } { some of these models. See page 74 }	
Bark, Scenic Half-Model (13½-in.), 108.....	.25
Battleship—U. S. S. Texas (3 ft. Hull), 197-198-199-200.....	1.00
Bottle, Clipper Ship in, 121-122.....	.50
Clipper, Baltimore (8-in.), 92.....	.25
Clipper Ship (20½-in. Hull), 51-52-53-R.....	1.00
Clipper, Simplified (9½-in. Hull), 219.....	.25
Constitution (21-in. Hull), 57-58-59-R.....	1.00
Covered Wagon (23½-in.), 118-119-120-R.....	1.00
Cruiser Indianapolis (12 in. long), 216.....	.25
Destroyer—U. S. S. Preston (31½-in. Hull), 125-126-127-R.....	1.00
Galleon Revenge (25-in.), 206-207-208-209.....	1.00
Galleon, Spanish Treasure (24-in.), 46-47.....	.50
Mayflower (17½-in. Hull), 83-84-85-R.....	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., 202-R.....	.50
Motorboat, 29-in. Cruiser, 63-64-R.....	.75
Motorboat, Working Scale Model Driven by Rubber Bands or Toy Outboard Motor (20-in. Hull), 196.....	.25
Liner—Bremen (20 in. long), 158A.....	.50
Liner—Manhattan (12 in. long), 204.....	.25
Pirate Galley or Felucca (20-in.), 44-45-R.....	.75
Roman Galley (19-in.), 138-139-R.....	.75
Sails—Square and Fore-and-Aft for Whaler Wanderer or any Model, 185-186.....	.50
Santa Maria (18-in. Hull), 74-75-76-R.....	1.00
Schooner—Bluenose (17½-in.), 110-111-112-R.....	1.00
Sedan Chair, Queen's (12-in.), 123-124.....	.50
Stagecoach, Concord (20½-in.), 115-116-117-R.....	1.00
Stagecoach (Cody), with Horses (Coach Body 13 in. Long), 144-145-146-R.....	1.00
Steamboat, Mississippi (19½-in.), 94-95-96-R.....	1.00
Viking Ship (20½-in.), 61-62-R.....	.75
Weather Vane, Ship Model (30-in.), 66.....	.25
Whaler—Wanderer (20½-in.), 151 to 154.....	1.00
Yacht, Sea Scout, 42-in. Racing, 106-107-R.....	.75
Yacht, 20-in. Racing, 48-R.....	.50

Toys

Airplane Cockpit with Controls, 114.....	.25
Birds and Animals, Jig-sawed, 56.....	.25
Doll's House, Colonial, 72.....	.25
Drill Press, Lathe, Saw, etc., 113.....	.25
Dump Truck, Fire Engine, etc., 101.....	.25

Miscellaneous

Bird-House Patterns (Full Size), P-1-2-3.....	.25
Log Cabin (Three Rooms), 134-R.....	.50
Perpetual Star Chart, 214.....	.25
Puzzles, Six Simple Block, 65.....	.25
Tool Cabinet, Bench Hook, etc., 30.....	.25
Workbench, 15.....	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....

No..... No..... No..... No.....

Patterns for

Reprints alone for

I am inclosing.....dollars.....cents.

Name

Street

City and State

Note: Please print your name and address very clearly. If you do not wish to cut this page, order on a separate sheet.

COMIC-STRIP "TALKIES"

(Continued from page 61)

with scouring soap, and secure in place so that they will come directly behind the bulbs. Screw the lamp receptacles just far enough from the tin to permit inserting the bulbs without letting them touch at the sides. Wire the receptacles in parallel.

To make the mount for the lens, cut a piece of the fiber board 2 by $3\frac{1}{2}$ times the diameter of the lens. Round it into a tube (marked *IT* in the drawings) in which the lens fits snugly, and glue the seam. Make two diaphragms *DI* for the lens of the same material as the tubes, cutting them as shown. The diameter of the circle encompassed by the dotted line is exactly the diameter of the lens and that represented by the solid line, $\frac{1}{2}$ in. less. The tabs are $\frac{1}{2}$ in. long. Insert tube *IT* in the hole in the front of the lantern to hold it steady as you place the lens and diaphragms as shown in the cross-section drawing and one of the photographs.

The outer tube (marked *OT*) is also cut from the fiber, measured off $\frac{1}{4}$ in. longer than the flat dimension of *IT*, and 1 in. narrower. Cut $\frac{1}{2}$ -in. tabs along the entire length of one side. Bend it firmly around *IT* and glue the seam. When dry, insert it in the hole in the lantern, tabs toward the inside. Bend the tabs and tack them to the wood. Tube *IT* should be able to slide easily within *OT*.

The last step is to make the "reel." Cut the comics into strips, leaving a $\frac{1}{2}$ -in. margin at the left-hand end of each. The margin on each new strip will go under the close-cut end of the preceding. A leader—a paper strip 1 ft. long—is pasted on the left of the completed reel; when the reel is rolled up, this leader will be on the outside. It is fed through slot *S* and out through *S*¹, with the pictures upside down. To keep the pictures flush with the back of the lantern and in focus, it is most convenient to cut two pieces of the fiber 7 by 3 in. These are curled a bit and thumbtacked in place over the strip.

For a test showing, suspend a sheet in front of the radio, place the lantern about 8 ft. away, darken the room, and light the bulbs. Slide the lens back and forth until the image is clear and sharp. Experiment with the lantern at different distances.

For the reading of the parts, it is most convenient to buy a second copy of the paper. Although the entire picture is shown on the screen, the audience will not read the lettering, which is all reversed.

Hook up the microphone according to the instructions coming with it, carry it to the actors, who should be stationed beyond sufficient sound insulation so that there will be no tendency for the radio set to start "howling," and make a final test. Speak clearly, not loudly, with the mouth about 6 in. from the instrument.

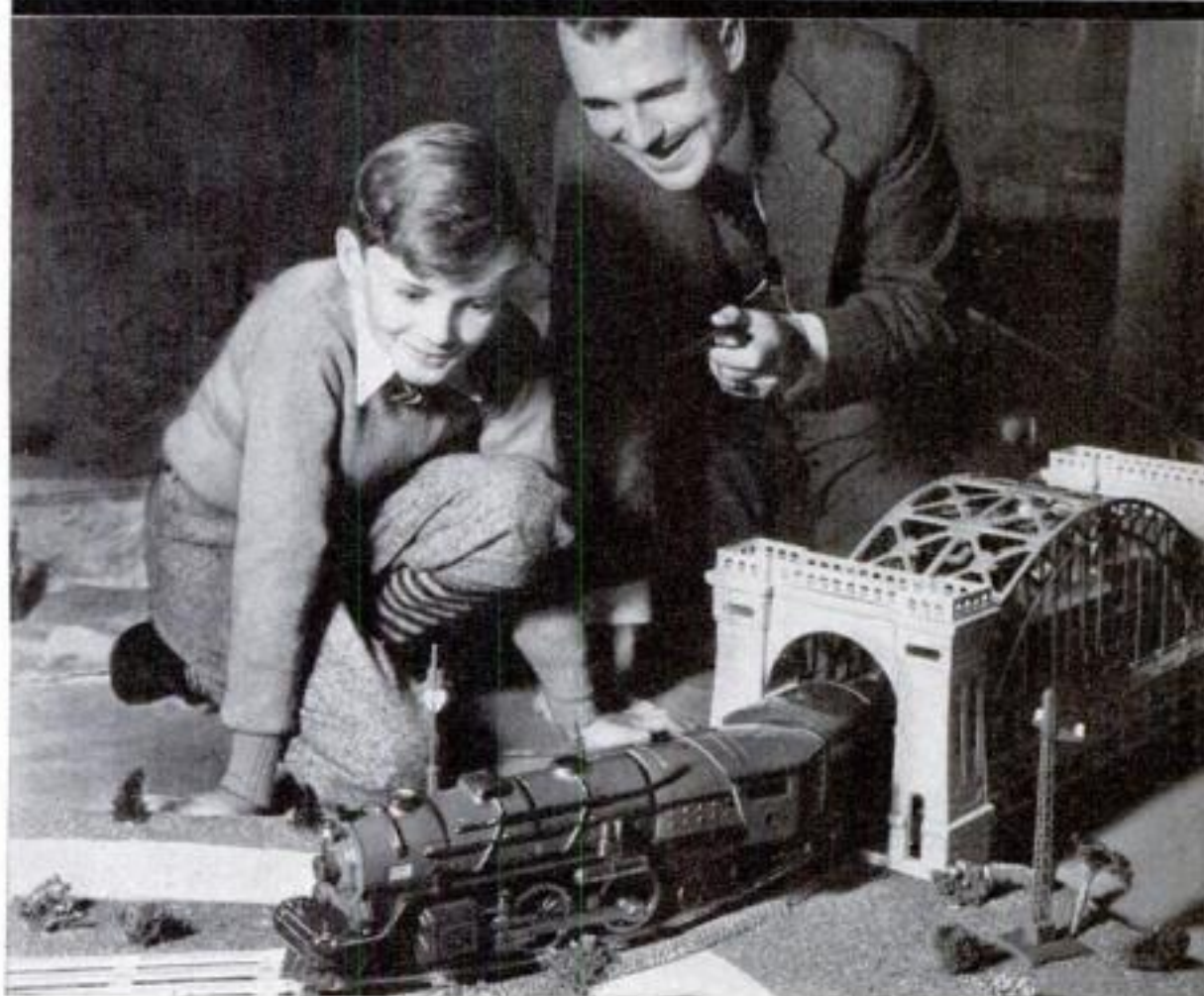
List of Materials

About 4 sq. ft. of any lumber cut into ten pieces as follows:

- D, D¹ 13 in. by 1" M
- A, A¹ 7 in. by 13 in. less twice the thickness of the wood used
- B, B¹ 6 in. by 1" M
- C, C¹ 1 in. by 1" M.
- E, E¹ $1\frac{1}{2}$ in. by 1" M less twice the thickness of the wood used

- 2 tin cans
- 2 flat-base lamp receptacles
- 1 magnifying glass at least 2 in. in diameter
- Some flexible cardboard or bookbinder's fiber board
- Lamp cord and connecting plug
- 2 lamps, 100-watt
- Sheet to serve as a screen
- 1 home-broadcasting microphone (costing in this case 55 cents)
- Radio receiving set

TO THE Luckiest men in the world A FATHER AND SON WHO ARE PALS



THIS Christmas give your son a present that will cement the partnership between you—and do even more—help him to become keen-witted, quick-thinking and resourceful. Such a gift is a Lionel Electric Train. For Lionel Trains, tracks, signals, switches and other railroad accessories are more than toys. They teach boys how to develop skill with their hands and brains. They help boys form the habit of thinking problems out for themselves by making problems a fascinating game. You and your boy will not only have the fun of building and operating a model railroad, but the opportunity to tackle actual problems of railroad operation.

Help him learn as he plays

Clip the coupon below. Take it to a Lionel dealer. He will give you, FREE, the new 52-page *Lionel Model Railroad Planning Book* that shows (1) how to plan and build a model railroad system and (2) what to

get to make it true to life to the last detail. Note: If it is not easy for you to go to a Lionel dealer's store—mail the coupon below to us and we will send you this expensive book if you send 10c to cover handling and mailing costs.

Chug! Chug! Chug!

An Amazing Invention

Now Lionel Electric Trains sound as well and look like real trains . . . they chug in life-like imitation of actual locomotives. This "CHUGGER" device is an exclusive Lionel feature. And, for the first time, all Lionel Electric Trains have Remote Control, which enables you to start, stop or reverse the locomotive from any distance. Lionel Electric Trains can be bought for as little as \$7.95. . . Lionel-Ives Electric Trains with Transformer-Station from \$5.75. . . Lionel-Ives Mechanicals (for junior) as low as \$1.25. (Prices subject to change.)



Tune in on Lionel's thrilling "True Railroad Adventures." Every Wednesday at 5:00 P. M. and Sunday at 4:00 P. M., E. S. T., over NBC-WJZ Network starting November 5th. Look in your newspaper under "True Railroad Adventures."

FREE
at your
dealer's



LIONEL CORPORATION, Dept. S-3, 15 East 26th Street, New York City

I enclose 10¢ to cover handling and mailing costs for my copy of the new Lionel Railroad Planning Book.

Name _____

Street _____

City _____

State _____

LIONEL *Electric* **TRAINS**



Boy—

When I Hook 'em!

They, uh!—stay hooked
!!!—!

A dull hook glides off the cartilage or bones of Mr. Fish's mouth. All you see is a swirl of water rings. Touch up the point of your hook on a Norton Pike Stone, if you want to see him in the frying pan.

"Most interesting subject!" you will say, as you lay down the Norton Pike booklet—*How to Sharpen*. "I had to read every word. The kinds of fast sharpeners and the kinds of oilstones should be taught boys and girls in school. My education was neglected. It has cost me more than the fish which got away."

Yes, oilstones make supersharp points on surgeons' needles and edges sharper than a razor on their knives. They sharpen the butcher's cleaver and the woodsman's axe. A stone for every edge. Experts use Norton Pike sharpening specialties. The booklet is free for your name and address on the coupon.

NORTON PIKE
Use what Experts use
Sharpening Specialties

BEHR-MANNING CORP.,
U. S. Sales Representatives
Dept. D, Troy, N. Y.

Please send me the Norton Pike book "How to Sharpen." I'm sharp enough to ask for it, since it's FREE.

Name.....

Address.....

My dealer is.....

HACK-SAW BLADES KEPT TOGETHER WITH RINGS



Loose-leaf notebook rings are used to hold together a supply of extra hack-saw blades

THE usual small assortment of reserve hack-saw blades kept about the bench or carried in the tool kit can be held together as shown above by snapping a small loose-leaf notebook ring through the holes in each end of the bunch.—F.W.B.

HOW TO MAKE SANDPAPER STICKS AND SLEEVES



Left to right, a scraper, sleeves drying on forms, two of the forms, and finished sleeves

USEFUL round sandpaper sticks for smoothing small, sharp curves can be made by coating various sizes of wooden dowels 3 or 4 in. long with surplus glue that will not keep overnight and then wrapping strips of sandpaper around them in spiral fashion. The sandpaper should be cut about 1 in. wide. Cord is wound around each spirally until the glue is dry. As these sticks may be held in the drill chuck of either a drill press or a lathe, they save much tedious work.

Those who have the newer sanding drums that work on the expansion principle and use sleeves of sandpaper may also make up their own sanding sleeves. Forms should be prepared about 1/16 in. larger than the diameter of the drum. These may be turned from any waste wood and left along enough for two or three sleeves. A piece of this form is then cut off lengthwise with the circular saw, so that it can be removed easily when the sleeve is dry. The paper should be cut on an angle of about 30 deg. for the larger sized drums and about 1/4 in. longer than the circumference of the form. This 1/4 in. is scraped clean of sand before the glue is applied. The paper is then glued, wrapped around the form, and bound.—H. CALDWELL.

QUICK WAY TO TRANSFER SMALL WOOD PATTERNS

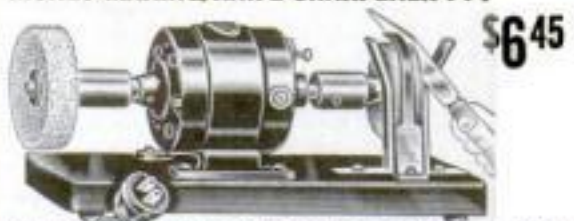
WHEN several duplicate wooden parts of irregular shape have to be jig-sawed or cut out by hand, it is not necessary to trace the pattern on each piece of stock. Simply cut out one piece and lay it on a sheet of carbon paper placed face down on the wood where it is desired to repeat the outline. Now hammer gently around the edges of your pattern, using a block, if necessary, to protect the stock. If the design is small, one rap on a block on top of the pattern is enough. Very fine tracery can be accurately reproduced in this way. After the duplicates have been cut out, the surplus carbon should be sanded off if the work is to be lacquered, as some carbon has a tendency to work up through the finish.—R. C. CROUSE.



JUNIOR HOME WORKSHOP SPECIAL \$3.95

High-grade polishing stand with adjustable split bearings; 3 jaw capacity drill chuck; 4" diam. grinding wheel; 4" wire scratch wheel; 4" circular saw; buffing wheel; 3" x 3 row bristle brush; set of 3 drill bits; 5 ft. leather belt and hook; saw table; mitre gauge; 2-speed pulley; polishing compound; tapering spindle. All for \$3.95. \$1.00 with order, balance C.O.D. Money refunded if not satisfied.

MONEY-MAKING KNIFE SHARPENER...



A wonderful spare-time or full-time money-maker. Sharpen knives in your home; or carry it with you. Easy to use. No experience needed. Put on a keen lasting edge in a jiffy. A sure repeat business. Will pay for itself quickly. 9" long, 4" high, weighs only 3 pounds. Only \$6.45.

ELECTRIC MOTOR APPLIANCE CORP.
2164 South Union Street CHICAGO, ILLINOIS

Make Beautiful Furniture at 1/10 STORE COST

Big New 72-Page Catalog F—full of bargains
Home woodworking book—color illustrations—blue prints—various wood grains, crotch, butt, quartered, burl, fiddleback, plain sawn, etc.—tells how to finish woods natural—foreign woods—jig saw puzzles. Articles you can make—desks, tables, book shelves, picture frames, etc. Send for it today—only 10c, or FREE with \$1.00 or more order.
SOLID MAHOGANY or WALNUT 28" L-106
Turned—Fluted and SANDED Leg **55¢ Each**
Craftsman Wood Service Company
We Ship All Over The World
2729 Mary Street Chicago, Ill.



CLAMPS
by Jorgensen
Clamps for all uses, of all types. Pony Clamp Fixtures that go on 1/4 inch pipe—make clamps of any length. Send \$3 plus postage (6 lb.) for 2 Pony Clamps, less pipe.
Jorgensen Handcrews, standard through industry, take firm grips on all shapes. Will not slip, spring or split. If dealer can't supply, send \$2.50 plus postage (6 lb.) for 2 No. 1 size—10" jaws, open to 6".
Write for Free Catalog
ADJUSTABLE CLAMP COMPANY
The Clamp Folks
408 N. Ashland Ave., Chicago, U. S. A.

GET INTO THE TOY BUSINESS AS OUR MANUFACTURER

Earn money casting our NEW LINE of hollow Toy Soldiers, Indians, 5 and 10c Automobiles, Ashtrays, etc. No special place or experience necessary as we furnish full instructions with moulds and cooperate in selling; also buy goods we need. Chance of a life-time for small with small capital to get into this new and profitable industry. If you mean strictly business and are over 21 write at once for details as CHRISTMAS RUSH is now starting.

METAL CAST PRODUCTS CO.
Dept. E 1696 Boston Road, New York



SHIP MODELS
U. S. S. TEXAS
The quick and easy road to ship modeling is to get one of our accurate scale construction sets. With them you can concentrate on the interesting part of the model. Similar sets for models of Flying Cloud, Destroyer Preston, Constitution, Spanish Galleon, Whaler Wanderer and many others. Also semi-finished hulls and all sorts of materials and fittings such as blocks, dead-eyes, anchors, steering wheels, guns, lifeboats, etc. Large 64-page photographically illustrated booklet, describing the above sent postpaid upon receipt of 10c (coin). Many persons on receiving this booklet, have discovered how simple and enjoyable is ship model making. Be sure to get your booklet before starting your model.
Model Ship Supply Co., Dept. T, Mineola, N. Y.

HINTS ON REPAIRING JIG-SAW PUZZLES

FINELY made wooden jig-saw puzzles often become broken and soiled from careless handling and much use. The chief damage is that caused by lost pieces. These may easily be replaced by new ones.

The puzzle must be assembled in order that the pattern may be obtained. Instead of making a rubbing, as is commonly done, turn the puzzle with the picture side down and cover the surface of the wood of all pieces that surround the hole with rubber cement, allowing it to dry. On a scrap of plywood, glue a piece of clean, white bond paper. When this is dry, coat the surface of the paper with rubber cement and let it dry.

Press this piece firmly over the hole in the puzzle, with the rubber-coated paper surface down. The cemented parts of the puzzle will adhere firmly to the paper. Lift the section as a unit from the body of the puzzle.

Saw in through one of the original cuts and continue around inside, close to the edges of the pattern pieces. Cutting slightly into the original pieces will do no harm.

Remove all the pieces from the scrap wood by lifting them gently with a knife blade. Replace them in the assembled puzzle and remove the dried rubber cement with an eraser or a small ball of the same material. Turn the puzzle over again and paint the new piece to match, using water-color or oil paints.

Small keys or tips may have become broken off, leaving small holes in the puzzle. If the broken piece is found, it may be glued into the whole piece into which it fits. If this small fragment has been lost, the hole can be plugged with a plastic wood composition or gesso mixed with enough fine sawdust to make it stiff. Press this plastic material firmly into all holes and let it dry at least eight hours. When solidly set, remove the groups of pieces which have been stuck together. Run the saw carefully through all cuts, sawing off the plug of cement at the point where it was broken, as this is usually a thin neck and likely to break again. Replace the repaired part in the assembled puzzle, turn it over, and paint.

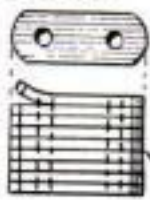
Where the picture has become loosened from the wood, it may be glued back into place with a toothpick dipped in glue. If spots of paper are torn off, glue bond paper to the spot and trim the edges with a sharp-pointed knife, and paint.

Should a large piece become broken, soak off the sections of picture and glue them to a scrap of plywood in the proper position. When dry, saw close to the edge.

If the back of the puzzle is badly soiled, cleat the whole thing securely, face down, and plane with a small block plane, the blade of which must be very sharp and set for a shallow cut. If preferred, the surface may be sanded, but this is slow and laborious.—W. L. FAUROT.

MANY THIN MODEL PARTS MADE AT ONCE

To SHAPE a large number of small brass or copper plates for a model, such as are required, for example, in making chocks and bolards, time can be saved by lightly soldering together the desired quantity of small pieces like laminated shims. The pieces are then shaped and drilled as a unit. When they are separated, they are certain to be of uniform size.—R. J. H.



PLATES SOLDERED,
SHAPE, AND
DRILLED



FINISHED
PLATE

MAKE IT WITH

STANLO

THE NEW METAL CONSTRUCTION TOY IN BRILLIANT COLORS



Three of the seven Stanlo Sets

● Automobiles, houses, trolley cars, boats, bridges, forts, steam shovels, factories, doll furniture and hundreds of other things—build them with STANLO. And best of all, every piece in a STANLO set is finished in brilliant colors so that you can obtain almost any color combination. ● An entirely new principle is used in fastening the pieces together and the finished project is absolutely rigid. There are no nuts or bolts to lose. ● A 24 page Instruction Book comes with each STANLO set. It shows over 125 different things to make and suggests many others. ● There are seven different STANLO Sets. (They cost—\$1.00, \$2.50, two at \$5.00, \$7.50 and two at \$10.00.) Ask your toy dealer to show you STANLO—it's entirely new. Write us for descriptive circular. ● If the set you want is not obtainable in your local store, we will send it, fully prepaid, upon receipt of price.



Lawn
Table

STANLO (Dept. E)

New Britain, Conn.

Made by the Makers of the World Famous
STANLEY TOOLS



Trolley Car



Bridge



Freighter



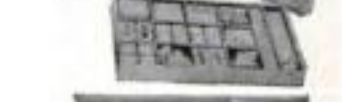
Dressing
Table



Stanlo No. 1
Price \$1.00



Stanlo No. 3
Price \$5.00



Stanlo No. 7 Price \$10.00

Driver Clutch

—a new workshop device

Pat. No.
1,930,319



The C55 Clutch, shown above, is a self-contained unit, factory tested up to 5 H.P. and ready for immediate attachment. Fits a 3/4" Shaft and has cone pulley diam. 5 1/2". Simple lever control. Price \$5.50. No. C40, not shown, is for lighter machines. Has 4" outside pulley diam. and 1/2" bore. The complete price is only \$3.85.

Walker-Turner Co., Inc.,
2123 Berckman St., Plainfield, N. J.
Kindly send me your free 1934 Catalog describing the clutch and Driver Power Tools.

Name.....
Address.....
City..... State.....

THE DRIVER FRICTION CLUTCH marks a startling new development in the power tool field that shop-owners will welcome. Using DRIVER CLUTCHES, machines can be stopped and started without throwing off belts or stopping motors. Wear and tear on both machines and belts is reduced, and substantial savings in electricity are made. Full loads can be applied after the motor is started so that fuses will not burn out. DRIVER CLUTCHES are simple to attach, and fit not only DRIVER POWER TOOLS but other makes as well. DRIVER CLUTCHES on your tools will produce savings, greater convenience and added utility.

Walker-Turner Co., Inc.



THREE-WAY PROTECTION

You'll get better and longer service from all workshop equipment when you start protecting it with 3-in-One—the oil that is specially-blended to do three jobs at one time. While it lubricates, it cleans working parts and prevents rust. Use it regularly and you'll save many a repair bill. All stores; handy cans and bottles.

3-IN-ONE OIL

for Every Workshop Use

WORLD'S FINEST PHOTO-INSTRUMENT

3 Cameras in One!



In all the world no other camera like this! Automatic Winding, Ground Glass Focusing before each exposure, using Standard Roll Film. Takes 3A, or 1/2, or 1/4 Post Card—7 to 19 pictures on a 6 exposure film. Equipped with best grade high-speed lenses.

NO DOUBLE EXPOSURES WITH "PAL KO!"
IT THINKS AND COUNTS for you.

Satisfactory performance guaranteed or money refunded!

Sold direct "From Manufacturer to You."

Free catalog Mailed on Request.

PAL KO, Inc. 821 W. Wash. Blvd., Dept. 2P
Chicago, Ill.

GO TO HIGH SCHOOL AT HOME

MAKE up the education you missed. Study at home in spare time. Your choice of subjects. Expert instruction. Personal service. You make quick progress because you are in a class by yourself. Diploma. Mail coupon today for interesting FREE BOOKLET.



INTERNATIONAL CORRESPONDENCE SCHOOLS

"The Universal University" Box 7686-G, Scranton, Pa.

Without cost or obligation, please send me full particulars about the course I have checked—

☐ English ☐ Bookkeeping ☐ Accounting
☐ Civil Service ☐ Salesmanship ☐ Advertising

Name.....

Address.....

QUICK-ACTING WINDER FOR CLOTHESLINES

ONE broom handle and a few pieces of pine will make this handy device for winding up a clothesline or wet fishline.

Cut two sidepieces $\frac{3}{4}$ by $1\frac{1}{2}$ by 16 in. and bore a 1-in. hole through the center of each. Three inches in from each end bore a $\frac{7}{8}$ -in. hole. A $\frac{7}{8}$ -in. piece of broomstick 13 in. long is inserted through the center holes, extend-

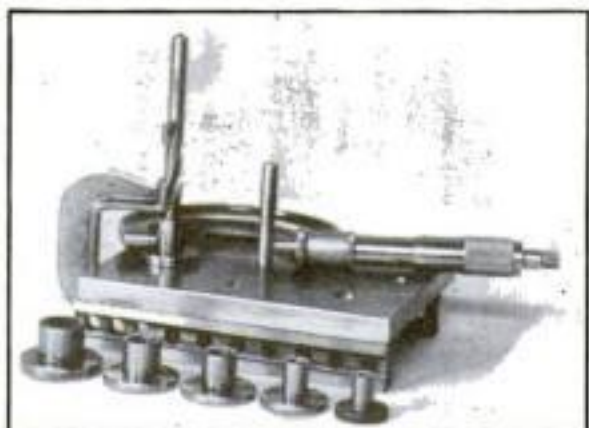


This homemade winder revolves on the central handle, which saves considerable time

ing out 5 in. to form a handle. If two nails are driven into the handle within the frame, and their heads snipped off and bent over, the handle will revolve freely yet will not slip out of the holes.

Two 8-in. pieces of broom handle are nailed firmly in place in the upper and lower holes to form the rack. A $1\frac{1}{2}$ -in. knob, attached to the side of the frame by a $2\frac{1}{2}$ -in. stove bolt, allows the operator to turn with one hand while the other hand grasps the handle.—RALPH SPRUNGMAN.

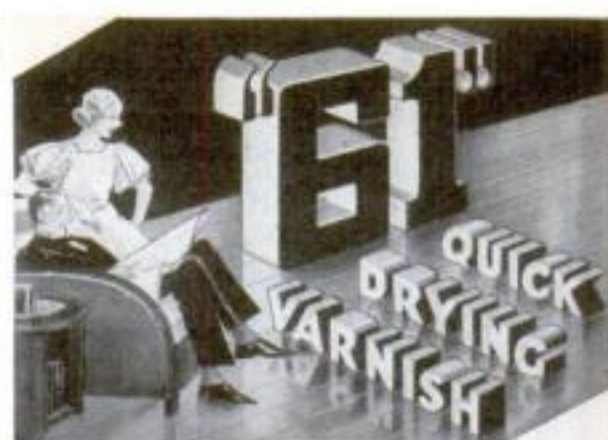
LAYING OUT DRILLED HOLES ACCURATELY



Bushings for laying out certain varieties of machine work with a high degree of accuracy

HOLES can be drilled and reamed quickly in jigs or dies with the aid of a set of hardened and ground bushings. For ordinary work six bushings are sufficient, with holes varying from $\frac{1}{4}$ to $\frac{3}{4}$ in. in diameter. It is important that the outside diameter of the bushings be concentric with the hole, and there should be a wall of metal at least $\frac{1}{8}$ in. thick; that is, for a $\frac{1}{4}$ -in. hole the outside diameter should be at least $\frac{1}{2}$ in.

The first hole is drilled and reamed and a pin is inserted. Then one of the bushings is set at the proper distance from the first hole by measuring the over-all distance with a micrometer as shown. If the center distance between the holes is 4 in., for example, and the pin is $\frac{1}{4}$ in. in diameter and the bushing 1 in. in outside diameter, the micrometer measurement will be 4 plus $\frac{1}{8}$ plus $\frac{1}{2}$ in., or 4 $\frac{3}{4}$ in. The bushing is clamped in position when properly located, and the hole is drilled and reamed. These bushings will enable work to be laid out more quickly and accurately than by any but the button method.—CHARLES MORGAN.



floor drudgery is ended when your floors are finished with "61" Quick Drying Varnish. No polishing or care required. NOT slippery! Heelproof, marproof and waterproof. Lasts for years on floors, furniture, woodwork, linoleum. Paint and hardware stores sell "61." Color card sent free. PRATT & LAMBERT-INC., 155 Tonawanda Street, Buffalo, N. Y.

PRATT & LAMBERT VARNISH PRODUCTS

Be Sure these two flying scale models are on your own Christmas list!



The New
BOEING 247

Nearly 5 foot span
weight 18 oz.

Highly detailed 1/4" scale authentic Cleveland-Designed model of the big 10 passenger planes now flying America's air lanes. This is actual photo of the "C-D" model itself. Colored entirely silver. Complete Kit SF-35 with everything needed, at your dealers, or express charges collect (weight not over 10 lbs.) \$6.50.

1930 HOWARD RACER

Redesigned. Faster. Prettier—all white. Simpler to build. All printed out wood. Easy for beginners. Span 15", length 13", weight 1.3 oz. Kit SF-18B, at dealers or direct, only \$1.50.



LISTEN! Why not give your friends C-D models, too. Send 3c stamp at once for new catalog No. 12. And be sure to order early. **Cleveland Model & Supply Co., Inc.**, 18665M W. 57th Street, Cleveland, Ohio.

HIGH POWERED TELESCOPE

Genuine 12 power multiple lens long range telescope. Giant telescope powerful enough

to see craters on moon or tell time on pocket watch block away, 5 sections. Approx. 3 ft. long. Fine lenses. Brass barrel. Also used as Powerful 512x vol. magn. microscope. Only \$1.69 postpaid! C.O.D. 24c extra.

Special-Superpower 16x telescope. Most Powerful in America For The Money! Similar to above, but more powerful, guaranteed to see 256 times larger in surface and 16 times closer, together with powerful microscope feature, only \$1.98 postpaid.

BROWNSCOPE CO., Dept. 45, 246 Fifth Ave., N. Y.

MAKE 200 TOYS an Hour... for \$1 Each!



Fun and profit, making and selling metal toys. Complete casting and coloring outfit only \$2.25. Each casting mold makes three different figures. Ask your dealer; if he can't supply write us. State choice of U. S. Soldiers, Indians, Machine Gunners, Sailors, Continental Soldiers, Football or Baseball players.

FREE BOOK of illustrations and instructions sent on request.

RAPAPORT BROS.
705 W. Ohio St., Chicago



The Midget "Five-in-One" Slide Rule is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions \$1.50. Fabricoid Case 50c extra. Sent C.O.D. if desired. Catalogue Free. **GILSON SLIDE RULE CO., Stuart, Florida**



Tricks With Electricity

Make things spin, jump, kick, buzz, shoot, shock, flash, mystify—all by electricity. Make lights obey voice, window novelties, trick lights, floating rings, spirit rapping—all kinds amusing, practical devices. Book tells how to do 200 stunts with 110 volts A.C. Postpaid \$1.

CUTTING & SONS, 123 S St., CAMPBELL, CALIF.

SHIP MODEL FITTINGS

BUILD THE "REVENGE"

Accurate, scale fittings, parts, and complete construction sets for this historic model. List free. Complete line of hulls, fittings and sets for U.S.S. Texas, as well as Sailing Ships, Yachts, Destroyers, etc. Send 15c for new illustrated catalog.

A. J. FISHER

1002-2 Etowah Ave. Royal Oak, Mich.



HOMESWORKSHOP GUILD

(Continued from page 63)

supply suggestions and plans for meetings and a model constitution and by-laws. Detailed instructions as to how to organize a local club, conduct the first meeting, elect officers, appoint committees, and all that you need to know about the movement are available.

Until larger quarters are required, meetings can be held without expense in a school-room, club, church hall, factory, or private residence. The Rockford Club started in the employees' meeting room of an industrial plant.

A SPEAKERS' bureau at the national headquarters is to arrange for lectures and demonstrations before the local clubs when a sufficient number of them are organized. A monthly news letter will suggest plans for meetings and programs. Professional craftsmen will aid members in the solution of specific problems. Methods of increasing interest and membership are to be relayed from one local group to another. Local exhibitions will be held by clubs and, when practical, a handicraft contest or national exhibitions, probably on an annual basis, will be held under the auspices of the Guild.

The Guild is to be entirely noncommercial. The small fee which the parent organization will collect from the local clubs will be used entirely for promotional activities for the benefit of the whole Guild.

In order to obtain the widest publicity and gain the utmost support for the new movement, the Guild has chosen POPULAR SCIENCE MONTHLY as its official organ and has made Arthur Wakeling, the Home Workshop Editor, a member of its board of directors. The activities of the Guild and of the local clubs will be reported from month to month in this magazine. It should be made clear, however, that the Guild idea originated in Rockford and that the headquarters are established there. This magazine has no other connection with the National Homeworkshop Guild (which should not be confused in any way with the Popular Science Homecraft Guild for distributing construction kits) than as a medium through which to give it adequate publicity and editorial support.

In every community there are men who are finding relaxation and pleasure in their workshops. They usually work alone and are unacquainted with others who have similar tastes in their own neighborhood. They are frequently poor mixers. But there is no reason why they should work longer by themselves. A local home workshop club will bring them together and be of immense value. If you wish to take advantage of this opportunity and help get a club organized in your locality, fill out the coupon below and send a large self-addressed, stamped envelope.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

Please tell me how to go about forming a local home workshop club and what the National Homeworkshop Guild will do to help. I am inclosing a self-addressed, stamped envelope.

Name

Address

City State

(Please print very clearly)

This Man knows

that it pays to look and feel well-off

He travels in a crack train like the 20th Century Limited. They say he has an unerring instinct for things that help him live well and more comfortably. His razor is the Schick Repeating Razor. It saves his time and always gives him a keen, smooth shave. It's compact to carry. And there are 20 blades in the handle ready for the instant blade change.



Schick Repeating Razor



A pull and a push of the handle changes blades. Takes one second!

Complete with 20 blades \$5. Extra clips of 20 blades 75¢. That's economy!

P.S. Want a new kind of pocket knife? Send only a quarter (25¢). You'll receive postpaid quite a surprise. It's the Schick Knife with a Schick super-keen blade. It's only 1/8 inch thick! No bulge in your pocket. You'll like it.

Magazine Repeating Razor Co., Dept. M, 230 Park Avenue, New York, N. Y.

BEAN'S CANOE SHOE

Made of high grade tan elk leather with double oil tanned moccasin sole, rubber heel and Talon Fastener. It is a combination "Slipper Shoe," used for many purposes around camp and cottage. Sizes 3 to 12.

Write for Fall Catalog Mfd. by

L.L.BEAN

322 Main St. Freeport Maine



\$2.65 Postpaid

HAENEL "100 SHOT" REPEATER

Latest Model 1933 Haenel repeating pistol. Sturdy, massive construction, easy cocking lever, 100 shot magazine. Accurate for target. Powerful for small game. Blue or Nickel finish, shoots B.B. steel shot. Weight 18 oz. Price with 500 shots Free—\$4.95. \$2.00 deposit on C. O. D.

FREE Catalog—Colts, Rifles, Binoculars, etc. HUDSON SPORTING GOODS, P-52 WARREN ST., NEW YORK



\$4.95

12 and 15 in. Flying

SCALE MODELS

Your Choice of 10 Different Models

Full fuselage Models, guaranteed to fly. Each complete in Construction Kit with all parts, materials and Plans and Instructions.

Monocoupe Sparrow Hawk Puss Moth
Polish Fighter Fokker D-8 Fokker Triplane
Boeing Fighter Sopwith Camel
Heath Parasol British S. E. 5

Any 2 for **60c** POSTPAID

IDEAL AEROPLANE & SUPPLY COMPANY, Inc. 28 West 10th Street New York, N. Y.

HARD TO GET HARDWARE

Do you need any special tool or odd size piece of metal you can't get at your local store? We can supply it from our own stock of the most varied, unusual and hard to get hardware items, tools and metals in odd shapes, sizes and lengths. We do not publish a catalog. Write us what you want or are interested in and we will quote you our price.

PATTERSON BROTHERS 27 Park Row, Dept. P.5. New York, N. Y.

Announcing Amazing Typewriter Bargain

New Remington Portable only 10c a Day

10-DAY FREE TRIAL OFFER

Only 10c a day buys this latest model Remington Portable!

Not a used typewriter. Not a rebuilt machine. It's a brand new, regulation Remington typewriter. Simple to operate, yet does the finest work. Full set of keys with large and small letters.

Try this typewriter in your home or office on our 10-day FREE TRIAL OFFER. If at the end of 10 days you do not agree that this Remington is the finest portable at any price, you can return it at our expense. Don't delay. Don't put it off. Mail the coupon today. Or use postcard if you prefer.

Write for our new catalogue showing the most complete line of portable and desk models ever offered.

FREE TOUCH TYPEWRITING COURSE



MAIL COUPON

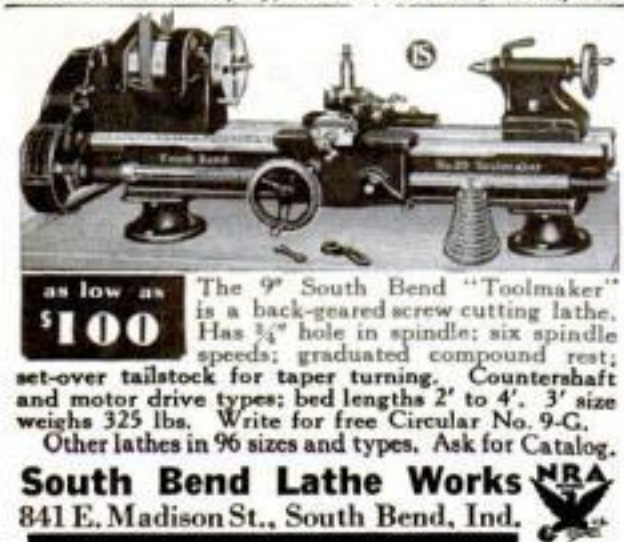
for full facts about this astounding offer

REMINGTON RAND INC., Dept. 705 BUFFALO, NEW YORK.

Please tell me how I can buy a new Remington Portable Typewriter for only 10c a day. Also enclose one of your new catalogues.

Name

Address



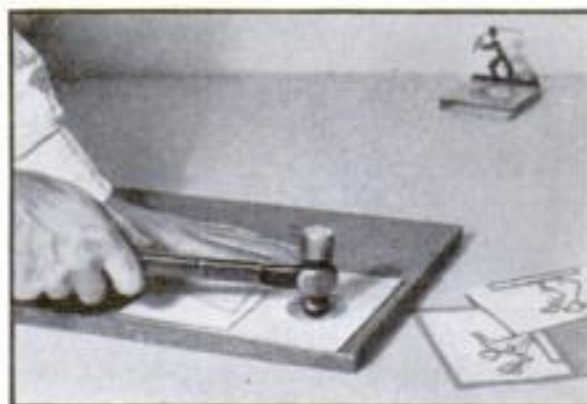
Jig-Sawed Metal Silhouettes Serve as
ASH-TRAY
ORNAMENTS

By Robert J. Williams

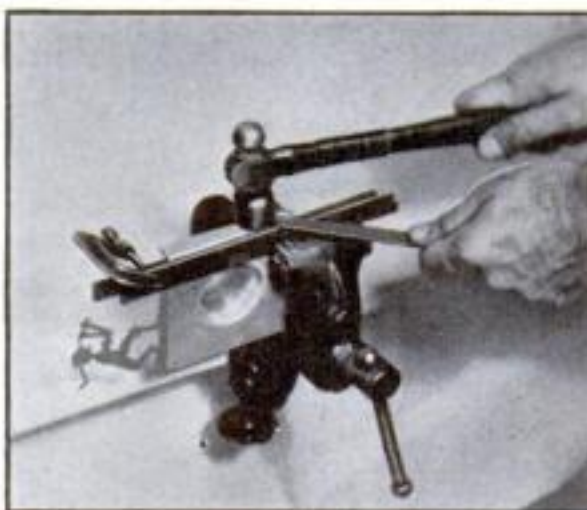
ALTHOUGH jig saws are ordinarily associated with wood cutting, light gage sheet metal is very easily sawed on them and with even better results as there is less likelihood that the small projecting parts will break off. A jig saw was used in cutting out the silhouette figures on the metal ash trays illustrated above. Any of the softer metals such as copper, aluminum, or zinc, about 18- or 20-gage, is satisfactory.

Since fishing is a universal sport, details will be given for constructing the comic fisherman ash tray first. It is made from a single sheet of 20-gage aluminum. The ash-cup circle and the dotted bending lines are marked off on the metal; then an outline of all the parts of the fisherman above the base line *A*, as indicated in the diagram, is drawn on a sheet of paper. This sheet of paper becomes the cutting pattern when it is attached to the aluminum. Auto-gasket cement makes an excellent adhesive for this purpose.

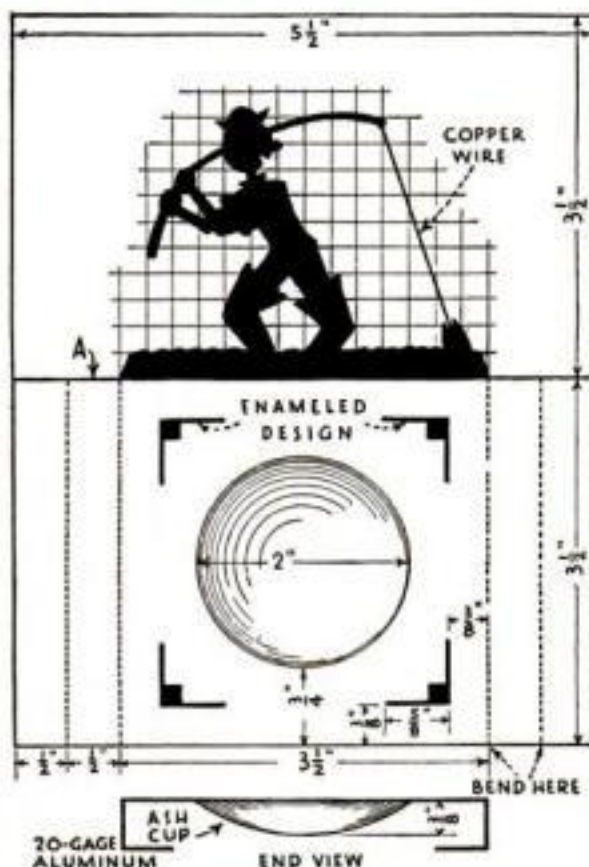
The aluminum is now ready for the jig saw. Instead of the fine picture-puzzle saw blades, use the somewhat heavier blade manu-



A smooth concave ash cup is formed by hammering the metal down over a hole in a board



When making the straight bends, keep a strip of wood between the metal and the hammer

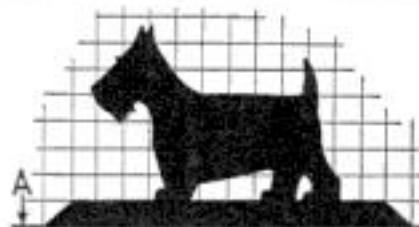


How to make the fisherman's tray. The design is drawn on $\frac{1}{4}$ -in. squares for enlarging

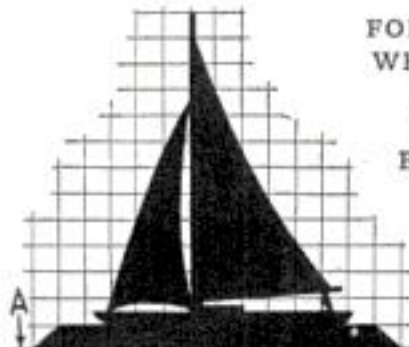
factured especially for metal cutting. Drive it at the slowest speed and cut clear of the outline so that the rough edges may be smoothed down to the lines with a file. Of course it is necessary to drill a hole for inserting the blade in the inclosed parts that are to be cut out.

The next operation is to form the ash cup, and this is not as difficult as it may appear. A hole 2 in. in diameter is jig-sawed in a hardwood board. The sheet of aluminum is placed with its scribed circle exactly over the hole in the board. Starting at the center of the circle and working out toward the edge, hammer the metal down into the hole. By tapping lightly the ash cup can be formed into a smooth and uniformly concave shape. Further smoothing of the cup is done with fine sandpaper, and at the same time the remainder of the paper pattern is sanded off. A final polish should then be carefully given with steel wool.

Square bends are easily made by clamping the aluminum between two iron bars along the dotted line. A piece of soft wood kept between the aluminum and the hammer will prevent any sharp dents. Bend the two leg angles first, then make a right angle bend along the base line A so the silhouette stands upright. The fishing line consists of a piece of copper wire with one end fastened



FOR THOSE
WHO LIKE
DOGS
AND
BOATS



FOR
TENNIS
AND
GOLF
FANS



Four other designs drawn on 1/4-in. squares. Below A they are like the fisherman's tray

through a small hole in the head of the fish and the other wrapped around the pole.

All parts above the base are enameled black or any desired color. To enhance the appearance of the tray, simple designs are laid out with a pointed instrument in each corner of the top and filled in with enamel. These designs may be left off, though putting them on gives a more finished appearance to the tray. To keep the unenameled part bright, give it a coating of thin, clear lacquer.

Any of the other silhouette figures may be substituted for the fisherman by using the proper cutting pattern above the base line A, as all dimensions are the same below that line. To enlarge the figures, draw a series of 1/4-in. squares and copy carefully from point to point.

TYPEWRITING LABELS ON ADHESIVE TAPE

EXCELLENT labels can be made from adhesive tape, but they are much neater if the lettering is typewritten. Of course, you can't put the tape in the typewriter without gumming up the roller. The solution is to stick the tape on a piece of wax paper or cellophane of a larger size and insert both in the machine. The tape is easily removed after typing, and the adhesive quality is not impaired.—W. E. LE COUNT.

Easy as A-B-C!

You Can Play Any Instrument In a Few Months This Delightful New Easy Way!



ANY one can easily learn music by this remarkable new method. And the cost is only a fraction of the old slow way. You don't need a private teacher. You study entirely at home. Almost before you realize it you are playing real tunes and melodies, both popular and classic, to please your friends, amuse yourself and make money. This newly perfected method of reading and playing music is as simple as reading a book. No private teacher could make it any clearer. The lessons come to you by mail at regular intervals—complete printed instructions, diagrams, all the music you need. You can select your own time to study or practice. And the cost averages only a few cents a day, including the music. If you play you are always in demand. Many invitations come to you—And you meet the kind of people you have always wanted to know.

LEARN BY NOTE

Piano Violin
Guitar Saxophone
Organ Ukulele
Tenor Banjo
Hawaiian Guitar
Piano Accordion
or any other
Instrument

Free Book Tells All

Our free booklet, "How You Can Master Music in Your Own Home"—contains an offer that makes the course available at a very low price. Also a Free Demonstration Lesson which shows how delightfully quick and easy this wonderfully simple method is.

Instruments supplied when needed, cash or credit. If you really want to become a good player on your favorite instrument, mail the coupon now—today. U. S. SCHOOL OF MUSIC, 812 Brunswick Bldg., New York City.



U. S. SCHOOL OF MUSIC,
812 Brunswick Bldg., New York City.

Please send me your free booklet, "How You Can Master Music in Your Own Home," with inspiring message by Dr. Frank Crane, Free Demonstration Lesson, and particulars of your easy payment plan. I am interested in the following course:

Have you above instrument?.....

Name

Address

City State

27" Flying Cloud, only \$4.



Supplied in Kit form, with simple instructions. Santa Maria, Mayflower, and others. \$4.50; Concord Coach or Corel Wagon, \$4.50. The "CONSTITUTION," accurately detailed, \$6.00. Spinning Wheel \$1.00.

18 IN. MODELS in Kit form, of Santa Maria, Mayflower, Clipper and La Pinta—with colored parts, decorated sails—each only \$1.00.

Send 3c stamp for beautifully illustrated catalog, by parcel post in U. S. or Canada. MINIATURE SHIP MODELS, Dept. NA, Perkassie, Penna. Canadian Office, 90 King St., West, Toronto

WORLD-WIDE TWO TUBE SHORT WAVE RECEIVER



12,500 Mc reception record established! Tunes from 10 to 200 meters. Gets foreign broadcasts, police calls, airplanes, amateurs, etc. direct! COMPLETE KIT (no drilling) with clear instructions to build this remarkable 2 tube receiver. Day cell or AC Model. Send \$1.00. Balance C.O.D. Satisfaction Guaranteed.

Free Short Wave Catalog S-12.

Harrison Radio Co., 142 Liberty Street, New York City

Automobile Racing—NEW BOOK!

Ten Chapters, 137 illustrations, of dirt and championship cars and drivers. How to build cars and bodies. Converting stock cars to 120 m.p.h. racers. Answers all questions on speeding up cars: superchargers, "revs," balance, speed, contest rules, track records, etc. Postpaid \$1.00. C.O.D. \$1.12. Order NOW. Ray F. Kuns, Dept. D, Madisonville, Cincinnati, Ohio.



BB MAGIC Get BB Magic at once. A wonderful shooter! adigest—tell how to hold, aim and handle rifles; become a crack shot. The principle of compressed air action that made the Benjamin Single Shot world famous has been applied to 25 shot automatic firing. Learn all about both rifles. **SEND NOW!**

BENJAMIN AIR RIFLE CO.
683 N. Broadway St. Louis, Mo.

If you like POPULAR SCIENCE MONTHLY why not pass the word along to your friends. When an article in this magazine strikes you as being unusually good, tell your friends to get a copy at the newsstand, and read it.

NEW

Boice-Crane 1934 Sensations



Only \$20.50

Send for Booklet "HOW TO SPIN METAL"

Besides woodturning, every craftsman can enjoy metal spinning too on a good lathe. Quickly and easily learned. Fully illustrated, 16 page booklet tells how. Learn about spinning before you buy any lathe. Booklet is instructive and authoritative. Only 25c. Catalog free with each copy. Both are ready. Send today.

No. 1100 Gap-Bed Lathe



Only \$17



W. B. & J. E. BOICE Dept. PS 12-J Toledo, Ohio

The 23rd Anniversary of Boice-Crane, this year, brings an amazing array of new tool sensations for craftsmen. New advancements, new ideas, new uses, and with an unsurpassed standard of performance. Write at once for new 1934 fully illustrated catalog. Stupendous values, at low prices you can't resist. Send 10c, refunded on first order.

Tilting ARBOR Saw

Dual cranks easily tilt and lower saw. Table always stays level, and so does lumber even on bevel cuts. Unsurpassed principle. Husky. Saws 2 1/4" thick. Also

dadoes, sands, bores, etc. Very practical.



NEW

4 inch JOINTER

Joints to 3/4" deep. Scale tells depth. Overall length 28". Full length fence guides boards steadily, tilts 2 ways, adjusts across tables. Finely built.

3 JIG SAWS

\$5.95 and up



Ideal Gap-Bed Lathes

Two sizes, 11" or 17" swing in gap. Normal swing over bed. Low priced. High quality. Ball bearing. 4 speed. Indexing head. Equips for woodturning, spinning, and metal turning.

A real SCIENTIST'S MICROSCOPE



made by
BAUSCH & LOMB

MANY discoveries of vast importance to science and humanity have been made with the microscope. Many more will be made, most of them by persons yet unknown.

For the beginning amateur who is really serious about that intriguing science, microscopy, Bausch & Lomb offer this genuine B&L Microscope.

Takes all accessories for most advanced work. Dustproof revolving nose-piece. Both coarse and fine adjustments. Magnification depends solely upon optics you select. Send for free literature!

BAUSCH & LOMB OPTICAL COMPANY
641 St. Paul Street Rochester, N. Y.

Bausch & Lomb Optical Company
641 St. Paul Street, Rochester, N. Y.
Please send me complete details on the FS Microscope.
Name.....
Street & No.....
City and State.....

BAUSCH & LOMB

• MICROSCOPE • FOLDING LABORATORY MODEL

Unheard of Value!

**BRAND NEW
SPECIAL
\$16⁵⁰**
Sold everywhere
for \$35.00

This is not a toy but a real high-power, precision instrument manufactured in America's largest microscope factory. Coarse and fine adjustment. Variable magnifications. Special adjusted stand to examine opaque as well as transparent objects. Jointed for inclination. Achromatic objectives. Stage clips, etc.

Write for Free Literature
B. M. LEVOY, Inc.

608 Fifth Avenue America's Largest Microscope Dealers New York City

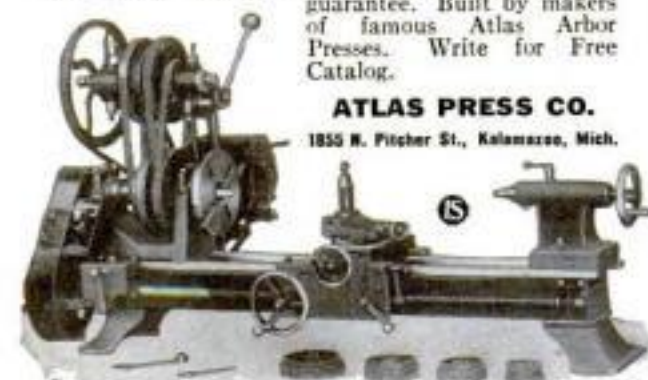
A Merry X-mas To Your Shop— A Happy New Year To You

The best, most useful present you could give yourself is an ATLAS lathe for your workshop.

Pre-recovery price of \$79 includes everything shown, except motor. With motor, \$89. On easy terms, a small down payment, then \$6 a month. Tools and fittings at very low prices, also.

MODERN, real 1933 design; V-belt drive; self-contained countershaft; 45 parts of Zamak, twice as strong as cast iron. Runs from lightsocket. BIG CAPACITY, 18" between centers. Also larger sizes. Cuts 4 to 72 threads. Adapts quickly to wood working by simple pulley change.

2 WEEKS TRIAL, satisfaction or money back guarantee. Built by makers of famous Atlas Arbor Presses. Write for Free Catalog.



ATLAS PRESS CO.
1855 N. Pitcher St., Kalamazoo, Mich.

MICROSCOPIC MARVELS IN YOUR WORKSHOP

(Continued from page 45)

etching solution is prepared by mixing one part of nitric acid (concentrated) with nine parts of alcohol. Etching is complete in ten to fifteen seconds.

Ordinary tincture of iodine can be used. Spread a drop of it on the polished surface and let it remain until the metal is discolored.

PERHAPS the quickest and simplest way is to dip the polished surface of the metal specimen into concentrated nitric acid and immediately plunge it into water. The acid can be dropped on the metal with a medicine dropper, instead of dipping. In this process, etching does not start until the acid has been diluted with water, and it continues only for an instant because of the rapid dilution.

Your specimen of cast iron can be examined under a low magnification. If the polishing and etching have been done properly, the structure of the metal will be seen plainly, its exact nature depending on whether the cast iron is white, gray, or mottled. Some specimens will show light, irregular patches of ferrite surrounded by free carbon or graphite. Cast iron contains carbon, silicon, phosphorous, sulphur, and manganese in addition to iron. It differs from steel in having more carbon, part or all of which may be in an uncombined state. The carbon percentage may be between two and five-tenths and four per cent.

Well-equipped metallurgists use vertical illumination for examining and photographing metal specimens, the light being directed downward through the microscope objective and then reflected back up through the same lenses. However, you can obtain satisfactory results by directing one or more beams of light downward on the metal, making them as nearly vertical as possible.

Move your microscope from the scrap-metal pile to the lumber rack, and you will find material for hours of fascinating entertainment. By looking at bits of wood, you will learn why some kinds are stronger than others, why some are flexible, and how the arrangement of cells determines grain pattern.

In wood, the cell is the building block. Cell structure determines whether the wood is stiff or flexible, heavy or light, soft or hard. Cell arrangement also determines the appearance which, in many cases, is the property of greatest value. Woods can be identified definitely by microscopic examination of cells and their arrangement.

IF YOU examine the end of a piece of oak under the lowest power of your microscope, you will find it is made up of circular cells, somewhat resembling a honeycomb from which the surface has been scraped. The cells are arranged in curved layers. If you could see the whole tree, you would find that these layers form rings, each representing a year's growth. Towards one edge of each layer are a number of very large cells. This part of the wood grew in the spring. The remainder, in which these cells are smaller, is summer and fall wood.

A piece of lumber made up mostly of spring-grown wood is not as strong as that which grew in the summer and fall. Here and there through the specimen, you will note streaks of cells that run roughly at right angles to the seasonal rings. These are the medullary rays which in the living tree serve to carry water between the inner and outer parts of the trunk and to store excess food.

Trees with broad leaves, such as the oak and maple, have three kinds of cells. The majority are wood fibers, which are long, narrow cells

(Continued on page 93)



A NEW WORLD for his XMAS There's a Real Gift

HIGH school boys and their grand-dads get equal delight and amazement from exploring the secret realms of Nature with the wonderful Wollensak Microscope. By the hour they glory in viewing the marvelous miracles of germs and pond-water animalcules—living creatures that swim, eat, battle split themselves into two separate beings, each alive and perfect. Endless fun and instruction. Wollensak Microscopes are simplified especially for amateurs. Ideal for making photomicrographs.

Model 425—Magnifies 100 to 425 diameters, \$18.50
Model 150—Magnifies 70 to 150 diameters, \$12.50
Model 100—Magnifies 100 diameters . . . \$5.00
Slide Set—Material for slide-making at home, \$3.50

At dealers or direct, shipped prepaid. Or C. O. D. Money-back guarantee. Catalog of Microscopes, Telescopes, Binoculars, free. Order today.

WOLLENSAK OPTICAL CO., 878 Hudson Avenue, Rochester, N. Y.

Here's Radio's
Greatest
Bargain
Catalog!

It's FREE!
Send for
Your
Copy
NOW!

Radio's Greatest Bargain Book! Over 30,000 items! Sets, Tubes, Speakers, Replacement Parts, Kits, Etc. Special sections on Short Wave, Public Address, etc. Nationally advertised merchandise at the LOWEST WHOLESALE PRICES direct from the largest company of its kind! Get your copy of this Big 160 page FREE Book of Bargains before supply is exhausted. WRITE TODAY to Dept. PS-123.

Wholesale Radio Service Co. Inc.
100 Sixth Ave., New York, N. Y.

\$2 WOOD LATHE

Fits need for inexpensive, smooth-running lathe. Runs from your treadle or fractional H.P. motor. Face plate and driving dog attachments included. Also list of 20 articles possible to turn on this lathe. Sent postpaid on receipt of \$2.00, outside U. S., \$2.25.

Write for full description of all our tools, including \$1.50 "Puzzle-maker" Jig Saw, \$2.50 Drill Press, \$1.00 Horizontal Disc Sander, etc.

J&H METAL PRODUCTS CO.

Specifications: 15" long overall, 6" high. Takes pieces up to 9 1/2" long, 2 1/2" in diameter. All metal construction. Fully adjustable. 2 speed.

"The Giftmaker"

490 St. Paul Street, Rochester, N. Y.

FORMS TO CAST LEAD SOLDIERS, INDIANS, TRAPPERS, Hunters, wild and Farm Animals. 222 Wonderful "True to Life" models. Easy and inexpensive to make. I furnish all necessary material. Send 5c Stamp for Illustrated Catalogue.

Henry C. Schiercke, Ghent, New York

EARN MONEY AT HOME!

Invest your spare time in building ship models. Good demand among your friends. Quality construction sets with clear drawings are easy to finish. Hulls come fully shaped and sanded. "Golden Hind" set only \$9.75 plus 8 lbs. postage. Send 15c (coins) for interesting catalog of historic models and parts.

ROY HANCOCK
323 S. Douglas Ave., Portsmouth, Va.

BUILD POLLYWOG This Winter

\$22.50 STARTS YOU!

COMPLETE KIT Less Sail \$79.50

Anyone can build POLLYWOG—America's latest centerboard catboat—in one-half usual time with exclusive, new, Mead construction method! Kit includes finished nosepiece, frames, transoms, bidepiants cut to shape. KIT \$11.00 for example Photographic Step-by-Step Building Method and Illustrated Circular! Hurry!

MEAD GLIDERS
12 So. Market St., Dept. D-123, CHICAGO.

MAGNIFICATION Without Clear Definition Is USELESS!

The really important thing in Microscopy is not magnifying power—but CLEAR DEFINITION! Magnification can be increased by merely lengthening the tube. But only a precision-built microscope can increase the magnification without losing the sharply defined delineation. The CLEARFLEX Microscope (included in this Winner-set) is just such an instrument and it gives you 6,400 GUARANTEED—CLEAR—DEFINITE—NON-DISTORTED surface areas! With this SENSITIVE CUSHION CONTROLLED ADJUSTABLE "CLEARFLEX" and the complete Biological-Scientific equipment you have all you need to explore the "Invisible".



CONTENTS

Dissecting Scissors
Dissecting Blade
Dissecting Needle
Powerful Dissecting Microscope
11 Thin Professional Slides
Concave Center Slide
Prepared Slide
12 Cover Glasses
12 Slide Labels
Specimen Jar
Bottle of Balsam
Bottle of Xylol
Tweezers
Pipette
Glass Rod
Book of Lens Paper
Directions

\$4.00 including **80X** CLEARFLEX MICROSCOPE

SPECIAL OFFER—The above Biological Outfit (without microscope)..... **\$2.00**

Either set sent prepaid on receipt of price, plus 5% shipping expenses and insurance.

FREE—Descriptive Literature of other Winner-set unusual Values.

Our Policy—Guaranteed Satisfaction

J. H. Winn Manufacturing Co.

124 West 23rd Street New York City
WINNERSET "THE KEY TO INVISIBLE WORLDS"

POPULAR SCIENTIFIC SUPPLIES 1500

chemical and biological items including chemicals, stains, glassware, apparatus, instruments, microscopes, preserved and living specimens of plants, animals, and insects, collecting outfits, aquarium supplies, books, etc., are described in our new 24-page abridged, illustrated catalogue. Send 10c for copy of this catalogue. We will credit this amount on your first order for supplies. Source of Scientific Supplies for Schools and Colleges.

NEW YORK BIOLOGICAL SUPPLY CO.
Dept. No. 10, 34 Union Square, New York.



MICROSCOPES

Make a splendid Xmas gift for young and old; fascinating, interesting, instructive. Every instrument guaranteed as represented. Stands heavy metal; tubes nickel. Prices are postpaid.

70X Micro Outfit; most complete, with 12 slides, instruments, instructions, etc. **\$2.49**
No. 988—High School Model 100X; rack and pinion—**\$4.50**
No. 443—Student Model—200X; rack and pinion, tilting frame, 3 lenses, **\$9.95**
No. 650—Perfect Model—300X; same as No. 443, **\$15.95**
No. 446—Professional Model—400X; same as No. 443, **\$16.95**

Catalog: Micro and Telescopes, Binoculars, Air Guns, Firearms, etc. Send stamp, **P. LEE SALES CO.**, 35 West 32nd St., N. Y. City



200 POWER MICROSCOPE

New Brownscope "Conqueror"

Most powerful in America for anywhere near the money. Reveals invisible world in startling beauty. 200 diameters, 40,000 areas. Heavy frosted base, tilting any angle; triple objective lenses; large stage; fully adjustable mirror. Height, 8 1/2 inches. Reg. \$12.50 value. Complete with prepared and plain slides, dissecting needle and tweezers, at the amazing price of only \$2.90 postpaid.

\$2.90

BROWNSCOPE CO.

Dept. 46 246 Fifth Ave., New York

Big 3ft. Telescope

Five Sections. Brass bound. 10-Mile range.

Study Moon, Stars and distant objects with this powerful 8-X instrument. Special Eye Piece for viewing Sun, included FREE. Makes an ideal microscope. Guaranteed. Big value. Postpaid \$1.85. C. O. D. 15c extra.

BENNER & COMPANY, T-69, TRENTON, N. J.



SPECIAL OFFER ON MICROSCOPE SLIDE MAKING SET

Contains slide box, 12 slides, 12 covers, Canada Balsam, scissors, forceps, dissecting needle, dropper, razor blade and directions for mounting permanent slides. All for \$1.00 postpaid. Money refunded if not satisfied. Order yours now. Also send for free catalog showing entire microscope and supply line. **A. E. Waeldin**, 117 Fulton Street, New York, N. Y.

MICROSCOPIC MARVELS IN YOUR WORKSHOP

(Continued from page 92)

varying in size. If you look at a thin slice of wood cut parallel to the grain, you will see that the fibers are tapered at the ends and fit together like dovetail joints.

A second type of cell is the tracheid. It is wider and shorter than the fiber and its ends are not as sharp. The opening through it is wider and there are thin places in its walls, called pits. These pits, in life, are useful in water circulation. Sometimes the wood can be identified by the shape and arrangement of these pits.

The third type of cell is the vessel or duct, which resembles a sectional sewer pipe, and is made from rows of tracheid cells. These vessels may be a yard long and one one-hundredth inch wide in some trees. Walls are pitted.

While studying the wood fibers, you might compare them with steel. They are remarkably strong, sometimes possessing, according to some botanists, one fourth the tensile strength of steel, and one half that of wrought iron. You can find much entertainment in examining the structure of wood that has broken under a load or stress, and noting the odd shapes the fibers assume.

Coniferous woods, such as pine, do not have vessels or fibers. They are made up almost entirely of tracheids with pits that can be seen in the walls. The tracheids in pine are about one-sixteenth inch long. They serve both to produce strength and carry water. In examining a cross section of pine, you will notice that there is an abrupt change from spring wood, with its large cells, to autumn wood with small cells. Here and there you will find large openings surrounded by cells that are somewhat oval-shaped. These are resin ducts, lined with epithelial cells. Medullary rays can be seen running at right angles to the spring lines.

The preparation of wood specimens is not difficult. With a sharp plane set to cut very thin shavings, you can obtain all the longitudinal sections you want. With a sharp razor, you can shave off very thin slices, either with or across the grain. Wood is easier to cut if it is soaked for several days in water; and you can produce thinner and more uniform slices if you use a hand microtome. (P. S. M. June '33, p. 33.)

If you have occasion to do a great deal of work with various woods, you will profit by building up a library of photomicrographs showing cell arrangements in various woods. These can be used for identifying doubtful samples.

Speaking of photomicrographs, it might be well to describe a stunt that seems not to be generally known among microscopists, including advanced workers. A camera that has no focusing back can be used to make photomicrographs with success. This opens the field virtually to everyone owning an inexpensive camera. The process is simple:

First, focus the microscope sharply while your eye is focused at infinity. This is not at all difficult because your eye normally is that way when you are studying a specimen. Now set your camera at infinity. If there is no infinity mark on the scale ("Inf." or ∞), set it at 100 feet, because the average camera lens has its infinite focus at 100 feet and beyond. Place the camera, without removing its lens, in line with the microscope eyepiece, and provide some arrangement for keeping out stray light. The lens should be a fraction of an inch from the microscope eyepiece, say about one-fourth of an inch. Usually there is a reduction in magnification by this method, in comparison to a set-up employing only the microscope lens. However, the reduction is not great enough to interfere with the usefulness of the method.



Given FREE with this Microscope



Gem ready for use

Only Books of Their kind Free With Microscope

FOR beginners and advanced amateurs. Liberally illustrated, 20,000 words on how to recognize and classify specimens, grow them, photograph, mount, preserve, etc.

Gem Microscope has full range of magnifications from 75 to 300 diameters. Everything shown so clearly that highest power is seldom used. For \$18.00 you get Gem Microscope, two books, "Microscope Experiments Parts I and II," mounted specimen, glass slide, velvet-lined case. At dealers or direct, post-paid. Money-back guarantee. Why not order now? "MICROSCOPE HINTS"—10c. 24-page booklet, scientific, accurate, to help you get more fun from your microscope. Send ten cents in stamps.

Literature free on request.
BAUSCH & LOMB OPTICAL CO.
747 St. Paul St., Rochester, N. Y.

BAUSCH & LOMB



FREE! Send Coupon for New BIG TRAIN BOOK

American Flyer leads in size, speed, fun-features and real design. Catalog shows new steam type locomotives with patented ringing bell and lighted fire-box—also fun making automatic signals, stations, tunnels, bridges, etc. This is the year to get your American Flyer—Never again will prices be so low or values so great. American Flyer Trains were the sensation at the "Century of Progress". Dads, too, make railroading a hobby.

American Flyer Mfg. Co.
2236 S. Halsted St., Chicago, Ill.

SEND FREE TRAIN BOOK

Name.....
Address.....

American Flyer Trains

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

CHEMISTRY

A CAREER OF SERVICE
AND PROFIT



No field of human endeavor offers greater possibilities today than chemistry. All progress is dependent upon this fascinating science. And right at home, in spare time, you can learn the fundamentals by study of the International Correspondence Schools modern course. Thousands recommend it to you. Send for an interesting booklet—free.

DRAFTING OFFERS OPPORTUNITY TO TRAINED MEN

Drafting is a fascinating profession, and there is no limit to the progress you can make. Many leading draftsmen today started their careers by study of the I. C. S. Drafting Course. Let us send you complete information.



ELECTRICAL ENGINEERS ARE LEADERS IN MODERN PROGRESS



Just as certain as electricity is the power of the future, just as certain is the part electrical engineers will play in industrial progress. Many leading electrical engineers today took their first forward step by mailing a coupon to the I. C. S. at Scranton!

GOOD ENGLISH IS ESSENTIAL TO SUCCESS

People judge you by the way you speak, by the way you write. If poor English is your failing, all your other qualifications diminish because of it. In spare time, I. C. S. will teach you good English—a basic requirement to success in any field of endeavor. Ask for our free booklet.



INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 7663-G, Scranton, Penna.

Without obligation, send me full information on subject checked below:

- | | |
|--------------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> Chemistry | <input type="checkbox"/> Electrical Engineering |
| <input type="checkbox"/> Drafting | <input type="checkbox"/> Good English |
| <input type="checkbox"/> Architecture | <input type="checkbox"/> Highway Engineering |
| <input type="checkbox"/> Concrete Construction | <input type="checkbox"/> Agriculture |
| <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Poultry Farming |
| <input type="checkbox"/> Reading Shop Blueprints | <input type="checkbox"/> Radio |
| <input type="checkbox"/> Civil Engineering | <input type="checkbox"/> Accounting |
| <input type="checkbox"/> Aviation Engines | <input type="checkbox"/> Show Card Lettering |
| <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Advertising |
| <input type="checkbox"/> Refrigeration | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Air Conditioning | <input type="checkbox"/> High School Subjects |

Name.....

Address.....

BE A RAILWAY TRAFFIC INSPECTOR

Interesting, Well-Paid Work—A Growing Field

ACTIVE MEN—19 to 55—wanted for Railway and Bus Passenger Traffic Inspection Work. Healthful, outdoors; travel or stay near home. Rapid pay advances after a few months' experience. On completion of a few weeks' home-study, you can start at up to \$140 per month, plus expenses. For 15 yrs. we have located positions for our graduates or refunded tuition. Seize this opportunity. Write for Free Booklet.

Standard Business Training Institute
Dr. 312 Buffalo, N. Y.

A GOOD TIP FOR ALL RETAIL MERCHANTS



THE name of this man is unimportant. But the unique method he is successfully using to collect old and bad debts may prove an eye-opener to many a business man. He lives in my town and he owns an independent grocery

store, with plenty of competition from chain and strictly-cash stores.

I happened to drop into his store one day last winter while business conditions were at their worst in this little prairie town of ours. After exchanging a few commonplaces, we launched into a discussion of business problems in general and collection troubles, which are ever present, in particular.

"The worst of it all," protested this man, "is that the customer who has run up a large bill in this store invariably does the vanishing act. I don't mean skipping town. I mean moving their trade to another store. Soon as these bad debtors do get a little cash, they go and spend it at the chain or strictly-cash stores. My hardest job is to get them to come in here and do a little cash business as well as credit."

Just then an icy gust of wind swept the store as the door was thrown open and a red-faced, bulky man crossed the threshold.

"SEE here," he roared at the grocer, "I never had such a monstrous bill in all my life! It's an outrage, and I refuse to pay it."

"Just a minute," replied the grocer, "and I'll check up on it." After studying his account book and checking the original bill he turned to the customer once more.

"There has been some mistake. Your account is only half of this amount. I'm sorry; I apologize. I sent out those bills myself this month, so I must have made the mistake."

The anger on the customer's face slowly melted into an expression of genuine relief. And, of course, once learning that his bill was really only half of what the statement said, he didn't have the nerve to walk out without settling his account.

"Well, it worked," chuckled the grocer, after the man had gone. "You see, I was just about to tell you of this new experiment when he blew in."

"Two months ago I looked over all my accounts and picked out every old, uncollected debt. Incidentally, this bill I just collected was in the hands of an agency a year (Continued on page 95)



College Training

Over 200 noted Engineers, Business Men, and Educators helped prepare the special instruction which offers you college-grade vocational training at home.

High School in 2 Years

Our simplified, complete High School Course—specially prepared for home study by leading professors—meets all requirements for entrance to college, business, and leading professions. U. S. Government figures show that the high school graduate averages \$16 a week more than the grade school graduate, while the college man averages \$25 a week more than the high school graduate and \$41 a week more than the grade school graduate.

The University of the Home

No matter what your inclinations may be, you can't hope to succeed without proper training. Check kind of work preferred and let us send you full details without obligation.

American School

- Dept. G-937, Drexel Ave. at 58th St., Chicago
- | | |
|---------------------------|------------------------|
| Architecture & Building | Electrical Engineering |
| Automotive Engineering | Civil Engineering |
| Business Management | Complete Law |
| Higher Account's (C.P.A.) | Mechanical Engineering |
| Drafting & Designing | High School Course |

Name..... Age.....

Address.....

AVIATION Offers the Better Pay Jobs to LINCOLN-Trained Men

Come to LINCOLN

Where you are certain of getting the proper training to equip you for the big pay jobs in aviation.

Government Approved School. Unexcelled equipment. Training by Government Licensed Instructors, including blind flying, cross country, acrobatics, master mechanics, airplane and engine course. Now is the time to start training. Exceptional opportunities in both Central and South America as well as in U. S. Aviation courses taught in either English or Spanish. Write! State your age.

Lincoln Airplane & Flying School
216C Aircraft Bldg., Lincoln, Nebraska

WANTED—Ambitious Men and Women Become EXPERT ACCOUNTANTS EARN MORE—Get Rid of Money Worries

Trained Accountants command responsible positions and big incomes. Changed business conditions have enormously increased the demand. A new, "easy-to-understand" Course—simplifies Accountancy. Lessons prepared and teaching supervised by one of America's foremost accountants. We quickly and thoroughly train you in spare time at home for important executive accounting positions and to qualify for C.P.A. Exams. Bookkeeping experience not necessary. Low cost—easy terms. Send for FREE BOOK—TODAY. NO LETTER NECESSARY. Just mail this ad with your name and address. National School of Commerce, 536 S. Clark, Chicago, Dept. A-9



Want a Career in PHOTOGRAPHY?

Big opportunities. Learn quickly. 23 years experience training men and women for successful careers in Photography (commercial, news, portrait, motion picture). Personal attendance or Home Study. Free booklet. How to Succeed in Photography.

NEW YORK INSTITUTE OF PHOTOGRAPHY
18 West 33 St. (Dept. 5C) New York City

Structural Drafting

Here is an advanced HOME STUDY COURSE designed especially for ambitious JUNIOR DRAFTSMEN which you can learn easily and quickly. Send today for complete details.

CANTON TECHNICAL SCHOOL
1117 Seventeenth St., N. W., Canton, Ohio



\$1260 to \$3400 Year

Men-Women-18 to 50

STEADY WORK

Many 3rd Class Post-Master Appointments coming

Mail Coupon Today—SURE

FRANKLIN INSTITUTE
Dept. 5-282 Rochester, N. Y.
Rush FREE, list of U. S. Government big pay LIFE JOBS. 32-page book describing salaries, hours, work and how to qualify for a position.

Name _____
Address _____

FUN!

MAKE THIS Squirrel Lamp
Yes sir, out of a real squirrel! Also make ash-trays, book-ends, etc., using rabbits, frogs, etc. LEARN AT HOME TO MOUNT BIRDS, ANIMALS & BIRD; tax skins and make, run, decorate your room.

It's FUN! BIG profits in spare time!
Free book tells how.

FREE BOOK! Write TODAY for beautiful free book telling how to learn this fine hobby. Book is free. Contains many fine pictures. STATE YOUR AGE.

N. W. SCHOOL OF TAXIDERM, Dept. 3399 Omaha, Nebr.

DIESEL Offers YOU BIG OPPORTUNITIES

DIESEL NEWS IS BIG NEWS—The hand writing is on the wall. In every industry Diesel is fast replacing all other forms of power—creating thousands of jobs for trained men.

Enter this new virgin field now—join the ranks of successful HEMPHILL graduates—many graduates now being placed. We teach you in 8 to 12 weeks' time. Life membership. Free National Employment Service. Learn Diesel in our Big Nationally recommended Diesel Schools and Shops. Expert Diesel instructors—all practical training—many types of engines to overhaul and operate. No previous experience required. We teach you from the ground up. Diesel opportunities will amaze you! —our FREE DIESEL BOOK tells all.

WRITE FOR FREE BOOK

BOOK K Explains All Practical School Course
BOOK H Explains Home Study (by Mail) Course

HEMPHILL DIESEL ENGINEERING SCHOOLS, INC.
2102 San Fernando Rd., Los Angeles 503 Westlake North, Seattle, Wash.
1043 Pender Street, Vancouver, B. C. 2520 Walnut St., Denver, Colo.

Be a DENTIST

LEARN AT HOME

To make Crowns, Plates, Bridgework, etc., for Dentists. Easy practical way to learn mechanical dentistry at home in spare time. Full equipment of tools and materials included with course FREE. Low tuition. Easy terms. Write for FREE BOOK about this money making profession that is not affected by machine age.

McCarrie School of Mechanical Dentistry
207 N. Broad St. Dept. 592 Philadelphia, Pa.

GROW MUSHROOMS

We show you how; use cellar, idle space; plant all seasons; overnight crops. We buy; 540% profit; our service free. Act quick.

INTERSTATE MUSHROOM ASSOCIATION
CP-7357 Cottage Grove Ave., Chicago, Ill.

Secrets of Success

A GOOD TIP FOR ALL RETAIL MERCHANTS

(Continued from page 94)

ago and they couldn't realize a cent on it! Anyway, I selected several of the bad accounts, jacked up the bill ten or fifteen dollars and sent out statements. When the customers received them they were furious. They immediately made it their business to come in here and let me have a piece of their minds.

"But in each case their anger was appeased when they found I had made a mistake in the figures. And in each case, I received part or full payment on the bills before they left the store. You'd be surprised at the payments I've received in the last two months. Of course, I only use this method as a last resort, but it does work."—E.C.A., Hettinger, N. D.

MADE HIS OWN PLACE IN NEWSPAPER WORLD

IF THERE was one burning ambition in Paul Friggens' life, it was to become a newspaper man. That was what he wanted—and that was what he was going to have. Having trained for this profession in college, after graduation he set about looking for an opening in this field. But it wasn't as easy as that. Everywhere he was greeted with the same story—"Sorry, but there's nothing open now."

Broke and discouraged, Paul finally returned to his father's farm near Belle Fourche, South Dakota, a small town of 2,300 population. Taking stock of the situation, Paul came upon the same realization so many other men have in the last four years. To have a job, one must create a job.

With that thought in mind Paul began to study the territory in which he lived. He soon discovered that a vast area was being inadequately covered by news in the daily papers reaching that section of the country. Why not cover it himself? Accordingly, he opened a tiny, second story office and went into business for himself.

His first step was to write to the nearest Associated Press Office and offer his services for serving the territory which was at that time being inadequately covered. Results were immediately forthcoming. By return letter he was offered a job at regular "space rates." Then Paul went a step further. One by one he contacted the daily papers in that area and at the end of four months he had added ten dailies to his "string."

In the meantime he began a systematic building up of news sources in the territory. He called on weekly editors, county officials, agricul-

(Continued on page 96)

Make me PROVE that it is Easy to learn at home to fill a GOOD JOB in RADIO



GET MY FREE SAMPLE LESSON
Mail Coupon



Broadcasting Stations

Employ trained men continually for jobs paying up to \$5,000 a year.



Aircraft Radio

Radio is making flying safer. Radio operators employed through Civil Service Commission earn \$1,620 to \$2,800 a year.



Set Servicing

Spare-time set servicing pays many N.R.I. men \$200 to \$1,000 a year. Full-time men make as much as \$40, \$60 and \$75 a week.



Television

Television is the coming field. You can get ready for it through N. R. I. training.

Clip the coupon and mail it. I'm so sure I can train you at home in your spare time for a good job in Radio that I'll send you a sample lesson free.

Examine it, read it, see how clear and easy it is to understand. Then you will know why many men with less than a grammar school education and no technical experience have become Radio Experts and are earning two or three times their former pay as a result of my training.

Many Radio Experts Make \$40, \$60, \$75 a Week

It's hard to find a field with more opportunity awaiting the trained man. Why in 1931—right in the middle of the depression—the Radio Industry sold \$300,000,000 worth of sets and parts! Manufacturers alone employed over 100,000 people! 300,000 people worked in the industry. 16,000,000 sets in operation that need servicing from time to time! Over 600 great broadcasting stations. There's opportunity for you in Radio. Its future is certain. Television, short wave, police Radio, automobile Radio, loud speaker systems, aircraft Radio—in every branch, developments and improvements are taking place. Send me the coupon now. Read how easy and interesting I make learning at home. Read the letters from graduates who are earning real money in this fascinating industry. Read how I trained them in a few hours spare time each week.

Turn Your Spare Time Into Money

My book also tells how many of my students made \$5, \$10 and \$15 a week extra in spare time, soon after they enrolled. I give you plans and ideas that have made good spare-time money—\$200 to \$1,000 a year—for hundreds of fellows. My Course is famous as "the one that pays for itself."

Act Now—Mail Coupon Today

My offer of a free sample lesson plus my 64-page school catalog is open to all ambitious fellows over 15 years old. Find out what Radio offers YOU without the slightest obligation. MAIL THE COUPON NOW.

J. E. Smith, President

National Radio Institute
Dept. 3NP3, Washington, D. C.

MAIL NOW for FREE PROOF

J. E. SMITH, President
National Radio Institute
Dept. 3NP3
Washington, D. C.

I want to take advantage of your offer. Send me your Free Sample Lesson and your book, "Rich Rewards in Radio." I understand this request does not obligate me. (Please print plainly)

Name _____ Age _____
Address _____
City _____ State _____ **R**

One Year From Today What Will You Be Earning?

This may be the most important year in your life! Your whole future is apt to depend on how you take advantage of present business changes.

The "New Deal" is opening up new jobs, creating unusual opportunities, bringing back prosperity. But that does not insure prosperity for you. Only you can insure that.

For months—maybe years—employers will be able to pick and choose out of the millions now unemployed or dissatisfied with their work and pay. Naturally they will pick the men with most preparation and ability.

You should—you must—make yourself quickly more valuable—to protect what you have and to insure getting your share of the promotions and pay raises. It is being done by OTHERS—it can be done by YOU!

Ask us to send you full details about our new spare time training, and to explain how it prepares you to meet today's demands and opportunities, also about our salary-increasing plan. If you really are in earnest, you should investigate at once. Check your field below, write your name and address, and mail.

LaSalle Extension University Dept. 1283-R Chicago

Send me, free, the facts about the demands and opportunities in the business field I have checked—and about your training for that field.

- | | |
|---------------------------------------------------|------------------------------------------------|
| <input type="checkbox"/> Higher Accountancy | <input type="checkbox"/> Industrial Management |
| <input type="checkbox"/> Expert Bookkeeping | <input type="checkbox"/> Modern Foremanship |
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Law—LL. B. Degree |
| <input type="checkbox"/> C. P. A. Coaching | <input type="checkbox"/> Commercial Law |
| <input type="checkbox"/> Grocery Store Management | <input type="checkbox"/> Stenotypy |
| <input type="checkbox"/> Modern Salesmanship | <input type="checkbox"/> Effective Speaking |

Name

Present Position

Address

AVIATION

AVIATION depends upon engines, and expert knowledge of aviation engines is a long step toward success in this rapidly growing industry. International Correspondence Schools offer you a modern, complete course of instruction in aviation engines, covering fully every feature of this important subject. Mail the coupon for a free booklet.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 7663-G, Scranton, Penna.

Send me—free—your booklet on aviation and complete information on subject checked below:

- | | |
|-----------------------------------------------|-----------------------------------------|
| <input type="checkbox"/> Aviation Engines | <input type="checkbox"/> Diesel Engines |
| <input type="checkbox"/> Aviation Mechanic | <input type="checkbox"/> Radio |
| <input type="checkbox"/> Airplane Maintenance | <input type="checkbox"/> Chemistry |
| <input type="checkbox"/> Gas Engines | <input type="checkbox"/> Drafting |

Name

Address



**"Here's a Gift
Sure to be
Welcomed"**

Not only pleasure for Christmas, but also helpfulness for years to come.

**WEBSTER'S
COLLEGIATE**

A Merriam-Webster

The new Fourth Edition brings Webster's Collegiate right up to date. And the new low prices make it a bigger value than ever before. Thin-Paper Edition: Cloth, \$3.50; Fabric-bound, \$5.00; Leather, \$7.00; Limp Pigskin, \$7.50. Purchase of your book, or send order and remittance direct to the publishers, or write for full information.

G. & C. MERRIAM CO., 314 Broadway, Springfield, Mass.

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

Secrets of Success

MADE HIS OWN PLACE IN NEWSPAPER WORLD

(Continued from page 95)

tural and livestock associations, school and industrial heads, bankers and business men and explained that he had opened a news office for more intensified coverage of the area, and asked their cooperation. Weekly editors, he discovered, were glad to send him carbon copies of their stories which otherwise would have found no wider circulation, in return for a mimeographed weekly news service covering the highlights of the week's activities over the entire area which Friggens compiled from the various stories.

Friggens gradually has been expanding the work of his office. When wild cat activities in oil sprang up in the territory, he launched an oil reporting service, which is now mimeographed and generally recognized as authoritative.

Friggens has found that in his territory there are many topics which find a ready outlet in trade journals, and with a little effort has written them up and sold them to mechanics magazines, travel magazines, engineering, and many farm journals.

Still another service is his correspondence for a New York newspaper in which he discusses political, social, and economic questions in the states about him. News and feature photographs is another item which has enabled him to increase the business of his office.

Areas offering opportunity for building up a news bureau, and offices similar to that of Friggens' exist in most parts of the country. By studying the individual territory, making friends, and contacting news sources, persons with initiative and a little writing ability should be able to bring in a good many dollars each month.—D.F., Plankinton, S. D.

Cash Prizes

THIS department will give \$5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

FREE How To Secure A Government Position

Tells About These and Other Positions
RAILWAY POSTAL CLERK
\$1850 to \$2700 a year
POSTMASTER
\$1200 to \$2500 a year
POST OFFICE CLERK
\$1700 to \$2100 a year
R. F. D. MAIL CARRIER
\$1800 to \$2300 a year

FREE BOOK tells how I can help you get a Government Job. For 8 years I was Civil Service Examiner—have helped thousands. If citizen 18 to 50, you may qualify. Get ready NOW for a position in the future. Send for free book. Write or mail coupon TODAY.

A. R. PATTERSON, Civil Service Expert
1612 Wisner Bldg., Rochester, N. Y.
Please send me your free book "How to Secure a Government Position."
Name

Address

Need Cash?

UP TO \$950 a Day
DISTRIBUTING
TRIAL PACKAGES



Send me your name on a postcard and I'll show you how to make up to \$950 a day with my new Trial Package Advertising plan. Or I can put you on in spare time and give you a bona fide chance to make \$1.25 an hour for every hour you put in. No experience or capital needed. Your earnings start first day. Pleasant, easy work. Steady income all year 'round. It's nothing to get full details. No obligation. Don't wait till somebody else gets your territory. Send postcard or letter today for Free Plan, Facts, and Proof of Big Earnings. Do this now.

ALBERT MILLS, Pres.,
1220 Monmouth Ave., Cincinnati, Ohio.

TRI-STATE COLLEGE

DEGREE IN 2 YEARS



B.S. Degree in Civil, Electrical, Mechanical, Chemical, Aeronautical Engineering. Those who lack high school may make up work. Low costs. Students from all over the world. Write for catalog.

School of Engineering

50th Year 5123 College Ave., Angola, Ind.

REAL JOBS OPEN

For Trained Auto Mechanics

Step into big pay. Earn \$35 to \$70 a week. I train you in only 8 weeks at largest school of its kind in world. New practical shop plan. Learn with real tools... on real equipment. Write quick for Big Free Auto Book and Special Low Tuition offer. No obligation. Add. J. H. McSweeney.

McSweeney School, Dept. 6-12
Cleveland, Ohio

Learn TELEVISION

and other types Television at W9XAL. Thoro training qualifies for 1st class license. 95% grads passed federal exam to date. Practical experience on experimental visual station W9XAL. Medium and quasi-optic frequencies. Studios atop skyscraper. Placement bureau.

FIRST NATIONAL TELEVISION
3013 Power & Light Bldg., Kansas City, Mo.

Make Money at Home

Grow our famous Fancy White Queen Mushrooms. Experience unnecessary—we tell you how. Big demand, at highest prices. Marketing facilities furnished. Illustrated book free. Write today!

AMERICAN MUSHROOM INDUSTRIES, LTD.
263 Waukegan Bldg., Toronto, Ont.

EARN up to \$25 A WEEK or More!

ELECTRICITY

LEARN the fundamental principles of all electrical work in a school as old as the industry. Apply these principles under direction of competent instructors. Course complete in one school year. Modern plant, up-to-date methods, home-like surroundings. Visitors are always welcome. Investigate the school you plan to attend. Catalog on request.

BLISS ELECTRICAL SCHOOL
112 Takoma Ave., Washington, D. C.

Become a Radio Expert

GOOD JOBS

Learn RADIO-TELEVISION

Electricity—Talking Pictures—in Los Angeles

A good job awaits you in 1934 if you train immediately. Enroll with National, 28,000 graduates. Qualify as a radio repair man; television expert; sound expert; broadcaster; station technician; electrician and for many other jobs. Earn room and board while learning. We help you get job. For limited time we will allow coach railroad fare to Los Angeles. Send for free book which gives full details about different jobs you can qualify for, complete course of instruction and photographs of school operations.

NATIONAL RADIO & ELECTRICAL SCHOOL
Dept. PSR-12, 4006 So. Figueroa St., Los Angeles, Calif.
Please send me your big Free Book on Television, Talking Pictures, Radio and Electricity. Also details of R. R. fare offer.

Name.....
Address.....
City.....State.....

ENGINEERING and ARCHITECTURE

Intensive, Practical, Technical Courses, in Electrical, Mechanical, Structural, Architectural Engineering. Degree in 2 yrs. Diploma in 1 yr. Short courses in Electricity, Power Plant, Electric Refrigeration, Radio, Television, Drafting, Nonessentials eliminated. Time and Money Saved. Low tuition. Extensive modern equipment. Part-time work during training. 33 yrs. experience producing successful men. Write for catalog.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

Wrestling Book FREE

Wrestling taught at home, by mail, by greatest of all world champions—Farmer Burns and Frank Gotch. He is a wonderful athlete. Handle bigger, stronger men with ease. Learn the secrets of experts. Jiu-Jitsu, Physical Culture. Have perfect health, fame, a perfect body admired by both sexes. **FREE** 32 page illustrated prospectus, full of thrilling information, sent free. Tells how we teach expert wrestling at home. Send 2c to cover postage. Write now for your copy. State age.

FARMER BURNS SCHOOL
3399 Courtney Bldg., Omaha, Neb.

Learn Photography at HOME

Make money taking pictures. Prepare quickly during spare time. Also earn while you learn. No experience necessary. New easy method. Nothing else like it. Send at once for free book, *Opportunities in Modern Photography*, and full particulars.

AMERICAN SCHOOL OF PHOTOGRAPHY
Dept. 1369, 3601 Michigan Ave. Chicago, U.S.A.

JOBS Demonstrating and Selling...

Nationally advertised line of safety devices for large Ohio Mfg. Local man preferred capable of interviewing executives of schools, business concerns, public and private institutions, truck and bus owners, better homes and farms. Present earnings conservatively estimated at \$250 a month. Opportunity for advancement to distributors. References required. Write General Manager, Dept. 92-72, 221 Crane St., Dayton, Ohio.

CARTOON YOUR WAY TO SUCCESS!

DON'T COPY - LEARN TO ORIGINATE!

RAYE BURNS will teach you HOW to CREATE ORIGINAL CARTOONS at home that you can SELL! Course has 26 lessons and 600 illustrations. **\$2.85**

Send name and address for free details. Only...
RAYE BURNS SCHOOL, Dept. S-X, Box 2194, Cleveland, Ohio

Print Your Own

Cards, Stationery, Advertising, labels, paper, circulars, tags, etc. Save money and time. Sold direct from factory only. **Junior Press \$5.90, Job Press \$11, Power \$14.90.** Do popular raised printing like engraving with any of our presses. **Print for Others, Big Profits.** Pays for itself in a short time. Easy rules sent. Write for free catalog of outfits and all details. **The Kelsey Co., H-33, Meriden, Conn.**

Learn Advertising at Home

Make money in advertising. Prepare quickly during spare time. Also earn while you learn. No experience necessary. New easy method. Nothing else like it. Send at once for free booklet—*"Win Success in Advertising"*, and full particulars. No obligation.

Page-Davis School of Advertising
3601 Michigan Ave., Dept. 1369, Chicago, U. S. A.

Always mention **POPULAR SCIENCE MONTHLY** when answering advertisements in this magazine.

LIGHTING STUNTS

(Continued from page 65)

care in the selection of colored bulbs. Red ones make the material appear an unattractive brown. Better colors include blue, green, orange-amber, and yellow, all of which are standard lamp colors.

The next time you purchase a Christmas tree, get one that is alive and has its roots housed in a tub. Then, after the holiday season, set it out in the yard. Every Christmas thereafter you can use that tree for supporting a string or two of colored lamps.

A NOVEL way of employing clusters or strings of lamps for decorating the lawn is to use them in an ice mountain. Simply pile irregular chunks of clear ice over colored lamps of 25- or 40-watt size. When the lamps are burning at night, the ice pile will glow with countless colors, the more striking because of the prismatic action of the ice. If flasher buttons are placed in some of the sockets, the colored picture becomes a constantly changing one.

When arranging the ice-pile lighting system, use weatherproof electric cord and sockets. Each bulb is fitted with a rubber gasket that keeps water from getting into the socket, and is provided with a wire guard like those used on trouble lamps, to prevent breakage. All of these items can be obtained at any large electrical store. You will find that an ice mountain will last for weeks if the weather is reasonably cold. Chicken wire can be used for holding the ice, if unusual shapes are desired.

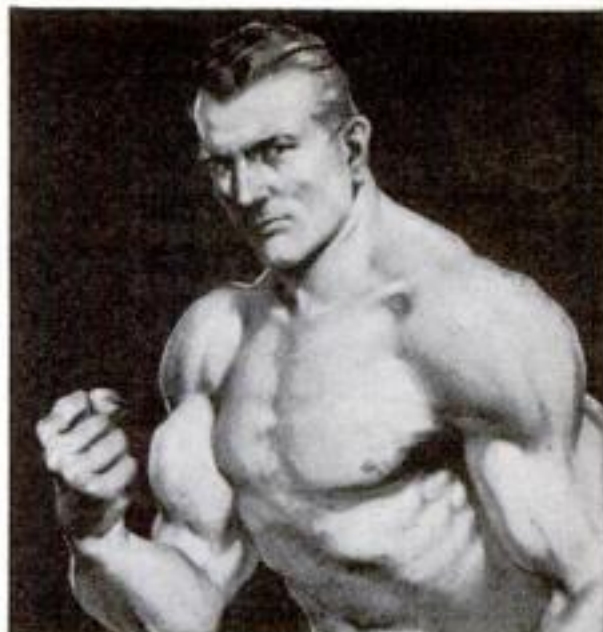
Christmas guests will feel more heartily welcomed if the walk leading to your house is outlined with candles. You can make the fixtures yourself from lengths of pipe painted white, cream, or any other color, and equipped with flame-shaped lamps at the tops. The pipe can be held in wood bases shaped like conventional candlesticks.

Many home owners have found that simple flood-lighting by means of projectors giving white or colored light is an easy way of achieving Christmas lighting. A few projectors are placed near the house and adjusted so that their rays bathe its walls. The projectors can be hidden behind shrubs or in hedges. You can purchase such equipment, or you can make suitable flood-light units by fitting 10-in. aluminum mixing bowls with weatherproof sockets, and using a rubber gasket to seal the bulb. Usually 100-watt lamps will be found large enough. For special occasions, where the lights are to be burned for two hours or less at a time, you can employ 35-cent photoflood bulbs, which are equivalent to 750-watt lamps. They are ideal if you want to make a picture of your lighted home.

Another lawn or entranceway ornament that is attractive, although a little more formal than some of the others, is the lighted pylon. Construct a tall, column-shaped box a foot or two square in cross section, with the sides open. Cover these with muslin and place colored lamps within. Christmas designs can be painted on the muslin.

THE silhouette in another form lends itself admirably to various Christmas lighting effects. For example, a cut-out figure of Santa and his reindeer team, perched on the porch roof or other low roof and brought into prominence by a flood light behind, which throws its rays on the wall of the house, will give passers-by something to talk about.

A modification of the silhouette idea is incorporated in special lighted shapes, which produce spectacular effects. These consist of two or more cut-out figures of Christmas trees or other objects, painted flat white and mounted a few (Continued on page 98)



Get this... STRONG MAN'S LIBRARY...

and **YOU** can build any part of your body to Giant Proportions!

ONLY **25c** EACH
All 6 for \$1.00

THINK OF IT! A muscle building course showing how to develop a definite part of your body for only 25c or six courses which show you how to develop the entire body for only \$1.00. That's my special offer. I will show you how to mould a mighty arm or how to mould a mighty chest, mighty legs, a mighty back or a grip of steel, or I will teach you strong man stunts.

Scientific Training

I show you how to add inches on your arm, how to put steel cables on your chest, how to get a back of might. I show you how to develop legs of a giant and a grip of steel. The strong man tricks which I reveal will amaze you and your friends. Moulding mighty men is the business of George F. Jowett, The Champion of Champions. Let him show you how to possess a herculean, Samson-like body.

Rush the Coupon TODAY!

All six books are profusely illustrated and will be sent to you by return mail, postpaid. Just slip a dollar bill in an envelope with the coupon below. For any single book just send a quarter. I will include a FREE copy of my book titled, "Nerves of Steel, Muscles like Iron."



FREE BOOK WITH PHOTOS OF FAMOUS STRONG MEN



"Nerves of Steel, Muscles like Iron" SENT FREE!

JOWETT INSTITUTE OF PHYSICAL CULTURE
Dept. 292b 422 Poplar St. Scranton, Pa.

George F. Jowett: Your proposition looks good to me. Send, by return mail, prepaid, the courses checked below for which I am enclosing—

- ☐ Moulding a Mighty Arm, 25c
- ☐ Moulding a Mighty Back, 25c
- ☐ Moulding a Mighty Grip, 25c
- ☐ Moulding a Mighty Chest, 25c
- ☐ Moulding Mighty Legs, 25c
- ☐ Strong Man Stunts Made Easy, 25c
- ☐ All 6 Books for \$1.00.

Name.....Age.....

Address.....

AT Hotel Cleveland the pleasant comforts of a fine club are combined with every service of the most modern hotel. In the heart of the city, Hotel Cleveland can be reached by covered passage from the Union Passenger Terminal and from a modern 2000-car garage.



1000 rooms, every one with bath. From \$2.50 single, \$4 double. Servidor Service. Floor Clerks. Three restaurants, including popular priced Coffee Shop.

HOTEL CLEVELAND

SUPPRESSED KNOWLEDGE OF THE AGES

What strange powers did the ancients possess? Where was the source of knowledge that made it possible for them to perform miracles? Were these profound secrets buried with ancient libraries, or are they buried beneath crumbling Temple walls?

These wise men of the past knew the mysteries of life, and personal power. This wisdom is not lost—it is withheld from the mass. It is offered freely TO YOU if with an open mind, you wish to step out of the rut of monotonous existence and MASTER YOUR LIFE.

THIS FREE BOOK

Men's intolerance has at times swept his achievements from the face of the earth, yet secret brotherhoods have preserved this sacred wisdom of the ages. The Rosicrucians, one of these ancient brotherhoods, INVITE YOU to write and secure a free copy of the "Wisdom of the Ages." It will point out how you may receive age-old truths. You can learn to MAKE YOUR LIFE ANEW—the fulfillment of your ideals awaits you. Address:

Fr. K.T.N.
ROSICRUCIAN BROTHERHOOD
SAN JOSE (AMORC) CALIFORNIA

LAW **STUDY AT HOME**
Legally trained men win high positions and big success in business and public life. Be independent. Greater opportunities now than ever before. Big corporations are headed by men with legal training. Earn \$3,000 to \$10,000 Annually.
We guide you step by step. You can train at home during spare time. Degree of LL. B. conferred. Successful graduates in every section of the United States. We furnish all text material, including fourteen-volume Law Library. Low cost, easy terms. Get our valuable 64-page "Law Training for Leadership" and "Evidence" books FREE. Send for them NOW.
LaSalle Extension University, Dept. 1283-L, Chicago

LIGHTING STUNTS FOR CHRISTMAS

(Continued from page 97)

inches apart. The smaller figures, of course, are in front, with those behind growing successively larger. Colored bulbs are mounted so that they cast their light over the fronts of the cut-outs. If flashers are used in the sockets, and lamps of different colors employed, striking color combinations appear every few seconds.

Stars are standard Christmas decorations and are particularly effective when fastened at the peaks of roofs, on outside walls, in tree tops, and elsewhere. You can purchase ready-made star ornaments which take 10-watt lamps, but you will find it a simple matter to make your own. Construct a rectangular or circular box deep enough to hold a socket and lamp. Over the front of the box nail a piece of plywood or composition wood that has a star cut in the center and is covered with translucent tracing cloth, shellacked muslin, or diffusing glass. Provide a heavy screw eye for hanging the box on a hook. Other stars consist merely of a plain wood or fiber piece with sockets mounted on the back, over holes through which bulb bases pass. The star can be painted silver or covered with tinfoil. The box structure can be modified so that it is itself in the form of a star. Stars should generally be more brilliant than surrounding lighting ornaments.

APPROPRIATE greetings such as "Merry Christmas" or "Yuletide Greetings" can be incorporated in electric signs placed across the front of your home or along the front porch roof. Perhaps the most satisfactory form of sign for home use consists of a long, narrow box just deep enough to hold a group of lamps and sockets, and equipped with cut-out letters in front. The letters are covered with shellacked muslin or diffusing glass.

The wreath is the type of lighted Christmas ornament most used indoors. Usually it is hung in a window or on a door. An attractive wreath can be made from a Christmas-tree string. First make a ring of stiff wire and tape the string to it so that the eight lamps are spaced evenly. Excess electric cord can be doubled up and taped in place. Cover the ring with laurel, evergreen or holly arranging the lamps so that they project through, all on the same side. Provide a colored cord for hanging the wreath to the window catch or a hook.

As in outside lighting of your home, you can use lamp strings to decorate interiors. You can suspend them over openings, across rooms near the ceiling, and, of course, on the Christmas tree. Usually the tree is the center of the interior lighting scheme, although it can be supported by lighted vases, pictures, potted plants, and table fountains. To decorate the center of the Christmas dinner table, you can use a miniature ice mountain on a large platter. The lamps can be of the usual Christmas-tree type, or several radio dial-light or flashlight bulbs may be used, wired in parallel and lighted by a doorbell transformer or batteries. Pile ice cubes over the lamps. If you are careful, you will not need to provide guards for the bulbs.

You may experience a little difficulty in connecting outdoor lighting equipment to your house circuit. Usually the problem can be solved by running one or more rubber-covered cables from an interior source of current. A simple way of getting the wire outdoors is to cut a board about 3 in. wide and long enough to extend across the bottom of a window when the sash is raised. Bore a hole or cut a notch in the board for the wire. Lower the sash against the board and insert a stick above the sash to lock the window, if no other locking device is provided for this purpose.

The following table is a guide for the proper selection of wire to be used in Christmas lighting layouts and will enable you to avoid overheating and loss of voltage and consequent lamp brilliancy through use of too small wire:

WIRING TABLE
(Rubber-Covered Wire)

Watts	Length of Run in Feet						B. & S. Gage Number
	25	50	100	150	200	250	
100	14	14	14	14	14	14	}
400	14	14	14	14	14	14	
500	14	14	14	12	12	10	
1,000	14	14	12	10			

For larger loads, use more circuits, in accordance with recommendations of your local electric company or contractor.

NOTE: The author wishes to acknowledge the courtesy of the General Electric Company in providing six of the photographs used on pages 64 and 65.



NOW READY

.. Your copy of the 1933 Home Workshop INDEX

HOW often have you hunted through your back copies of Popular Science Monthly to find some home workshop article you distinctly remembered seeing? And what a job it was! No one ever realizes what a wealth of material is published in this magazine until he has to go through a number of issues to find some particular item.

You can save yourself all this trouble by using the Home Workshop Annual Index. This lists alphabetically every article published on craftwork, shop methods, house repairs and short cuts, model making, radio, automobiles, and such hobbies as chemistry, microscopy, and astronomy.

Your copy of the 1933 Index is now ready and will be sent for ten cents to cover the cost of printing and mailing. A few copies of the 1932 Index are also still available.

Popular Science Monthly

381 Fourth Avenue, New York, N. Y.

Please send me the Home Workshop Index or Indexes checked below, for which I inclose ten cents each

☐ 1933

☐ 1932

Name

Street

City..... State.....

NOTE: Please print name and address very clearly

INVENTORS
PATENT
 YOUR IDEAS

Write for Free Book, HOW TO OBTAIN A PATENT and RECORD OF INVENTION—or send drawing or model for examination.

MILLER & MILLER
 REGISTERED PATENT ATTORNEYS

1638 Woolworth Bldg., Dept. C, New York
 205 EARLE BUILDING WASHINGTON, D. C.

Please send me your Free Book, "How to Obtain a Patent," and your "Record of Invention Form."

Name.....
 Address.....

NRA
 WE DO OUR PART

PATENTS—TRADEMARKS

All cases submitted given personal attention by members of the firm.

Form, "Evidence of Conception" and instructions, "How to Establish Your Rights"—FREE!

LANCASTER, ALLWINE & ROMMEL
 PATENT LAW OFFICES
 413 Bowen Building Washington, D. C.

INVENTIONS WANTED

Patented or unpatented. If you have an idea for sale, write **HARTLEY'S Inc., Box 928-D, Bangor, Maine.**

UNPATENTED IDEAS CAN BE SOLD

I tell you how and help you make the sale. Free particulars. (Copyrighted)

Write W. T. Greene
 921 Barrister Bldg. Washington, D. C.

PATENTS

BOOKLET FREE HIGHEST REFERENCES
 PROMPTNESS ASSURED BEST RESULTS

Send drawing or model for examination.

WATSON E. COLEMAN, Patent Lawyer
 724 Ninth Street Washington, D. C.

PATENTS SECURED
Trade-Marks Registered

I offer you the advantages of my 35 years experience as a patent lawyer and assure you of personal attention to your business.

TERMS REASONABLE.
 Book and Information Free.

L. F. RANDOLPH
 340 Victor Building Washington, D. C.

Inventions Promoted

Patented or Unpatented. In business over 30 years. Send drawing and description or model, or write for information. Complete facilities. References.

ADAM FISHER MFG. CO.
 183-D Enright, St. Louis, Mo.

MONEY IN MUSHROOMS

Earn upwards of \$25 weekly or more, growing for us in cellars or outbuildings. Booklet and particulars free. Established 25 years.

ADANAC MUSHROOM CO.
 Dept. J Toronto 10, Canada.

Inventions Wanted
 Patented or Unpatented

Our manufacturer-clients now want additional improved inventions. For information, write

Chartered Institute of American Inventors
 587 Barrister Building Washington, D. C.
 "World's Largest Organization of Inventors"

QUICK STARTS ON COLD MORNINGS

(Continued from page 60)

to a thinner oil and you won't put such a heavy load on your starter and battery and the moving parts will get better lubrication."

"Speaking of batteries, Gus," interrupted Nolan, "mine is always going dead in the winter. I can't seem to keep it up to charge, and we don't use the car much."

"That's the answer," Gus explained. "Besides, you probably do all your driving at night. With parking and everything, your generator doesn't get a chance to charge the battery."

"CAN'T I get around that some way?" Nolan asked. "I can't be trotting my battery to a service station every week."

"You wouldn't have to if you did some daylight driving," replied Gus. "But increasing the charging rate of your generator will help some."

"How do you do that?" Nolan asked. "I'll do it for you," offered Gus. "Then you'll know how it's done. But first of all, we've got to make sure your battery isn't too badly discharged. You get your hydrometer and test the battery readings while I run out to the service car and pick up a screw driver and a pair of pliers."

"Battery seems O. K.," Nolan reported when Gus returned. "Reads almost full charge."

Gus bent over the forward part of the motor and lifted a metal cover from the rear end of the generator. The commutator and its brushes were in plain view.

Indicating one of the brushes, Gus said, "This one is called the third brush and regulates the generator. To change the amount of current the generator pushes into the battery all we've got to do is move it along the commutator one way or the other. By the way, what's the highest charge reading you get on your dash ammeter?"

"Oh, about eighteen amps," Nolan replied.

"For winter driving in this car, it ought to be about twenty, so we'll increase it two amps."

Gus loosened the adjusting screw on the side of the generator housing and pushed the brush toward the motor block. "Moving it this way, increases the charging rate," he explained. "Moving it the other way decreases it."

"That ought to do it," he added as he fitted the cover back in place. "Now let's take her out for a test run and see how near I came to hitting it on the nose."

Nolan grinned with satisfaction as the motor started with the first effort.

As they gained speed, Gus watched first the ammeter and then the speedometer. When the dial showed twenty-five miles an hour, he nudged Nolan and pointed at the ammeter. "Just about twenty amps," he said. "That'll help your battery some, but don't forget to change it back to normal when spring comes around."

"BY THE way, Gus," Nolan said as the car coasted to a stop in the driveway, "you haven't tipped me off on any tricks I can use when the motor won't start."

"Hot water poured over the intake manifold will generally make even the coldest car perk," Gus replied. "And if that doesn't work, you can always pour a little ether into the air intake of the carburetor."

"But the important things are good gas, a hot spark, winter oil, and a fully charged battery. And incidentally," he added with a wink, "if you'd fit that garage of yours with insulating board, you'd find the old bus wouldn't get so cold."

Pointers on Patents



Now Mr. Attorney... what do you think of this idea?

THAT'S what inventors most often ask of me—or of any Patent Attorney. They want our opinion of the value, the "sale-ability" of their ideas. Often what they really want is encouragement. They long to have someone support their own belief—secret or otherwise—that "there's millions in it."

Now, no one ever asks a doctor whether or not a newborn baby will grow up to be a poet or a banker or an engineer. The doctor's business is to take care of the baby professionally, after its advent, and treat it for any ailment that may be present.

The Patent Attorney's business is to make sure, so far as he can, that all legal requirements have been met and covered in his client's Patent Application; and then to give his experienced, whole hearted assistance to help obtain the best Patent procurable.

"Encouragement" Is Too Often Misleading

The O'Brien Organization will give its opinion on the Patentability of your invention—not its marketability. We hold it unethical for a Patent Attorney to estimate the eventual worth of an idea. And so thinks every reputable Patent practitioner. Not only would it be unfair and discouraging because it might be an under-estimate—but there's the greater danger of being doubly unfair and conjuring up false hopes for the inventor through an over-estimate.

Our service to inventors, manufacturers and attorneys is one of seasoned legal assistance in Patent and Trademark matters. Beyond that we do not attempt to go.

This FREE Book
 shows how

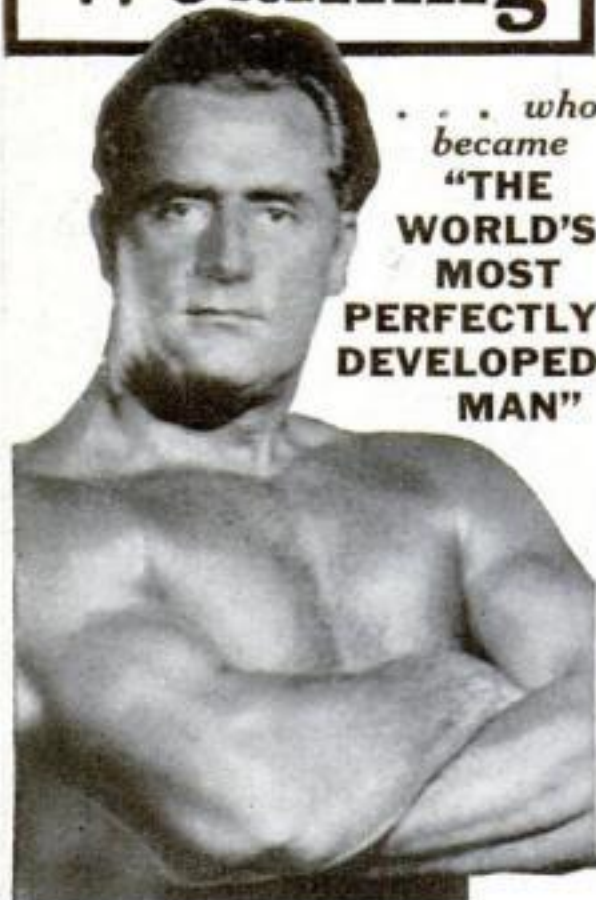


CLARENCE A. O'BRIEN
 REGISTERED PATENT ATTORNEY
 885 Adams Building
 WASHINGTON, D. C.

Without obligation, send me your booklet "How to Obtain a Patent" outlining your Patent and Trademark service; also send me your "Record of Invention" form.

Name.....
 Street.....
 City.....
 State.....

The 97-lb. Weakling



... who became
"THE
WORLD'S
MOST
PERFECTLY
DEVELOPED
MAN"

By CHARLES ATLAS

Holder of the title: "The World's Most Perfectly Developed Man," won in open competition in the only National and International contests held during the past 15 years.

THEY used to think there wasn't much hope for me. I weighed only 97 pounds. I was a sickly scare-crow. Then I discovered *Dynamic Tension*. It gave me the body that twice won the title, "The World's Most Perfectly Developed Man." Now I make you this amazing offer: At my own risk I'll give you PROOF in just 7 days that my same method can make you over into a NEW MAN of giant power and energy! No "ifs"—"ands"—or "maybes." Just tell me where you want handsome, steel-like muscles. Are you fat and flabby? Or skinny and gawky? Are you short-winded, pepless? Do you hold back and let others walk off with the prettiest girls, the best jobs. Give me just 7 days! I'll PROVE that *Dynamic Tension*—without any weights or pulleys that may strain your heart or other vital organs, pills, or unnatural dieting—can make you a healthy, confident, powerful HE-MAN! In just a few minutes a day!

Send for FREE Book!

Mail coupon or a postal card NOW for my illustrated book, "Everlasting Health and Strength." Tells all about *Dynamic Tension*. Shows actual photos. It's a valuable book! And it's FREE. Send for your copy today. Address me personally, Charles Atlas, Dept. 1-12, 133 East 23rd Street, New York City.



CHARLES ATLAS, Dept. 1-12,
133 East 23rd Street, New York City

I want the proof that your system of DYNAMIC TENSION will make a New Man of me—give me healthy, husky body and big muscle development. Send me your free book, "Everlasting Health and Strength."

Name.....
(Please print or write plainly)

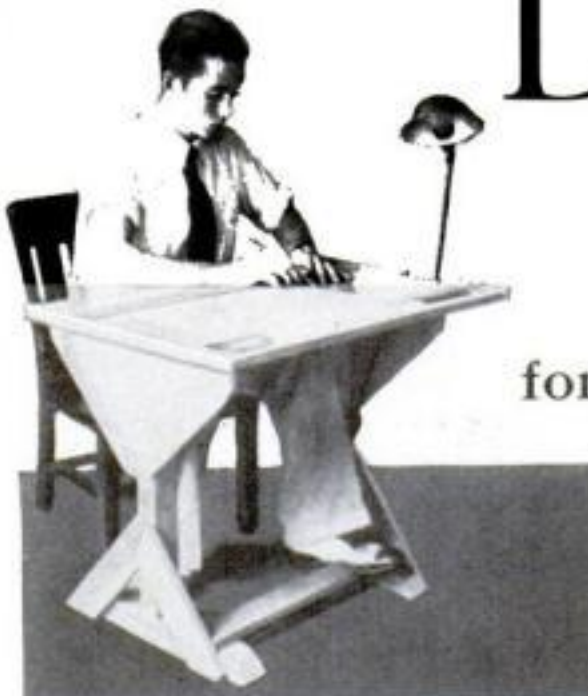
Address.....

City..... State.....

© 1935 C.A. Ltd.

Constructing a Light, Adjustable DRAFTING TABLE

for Home Workshop Use

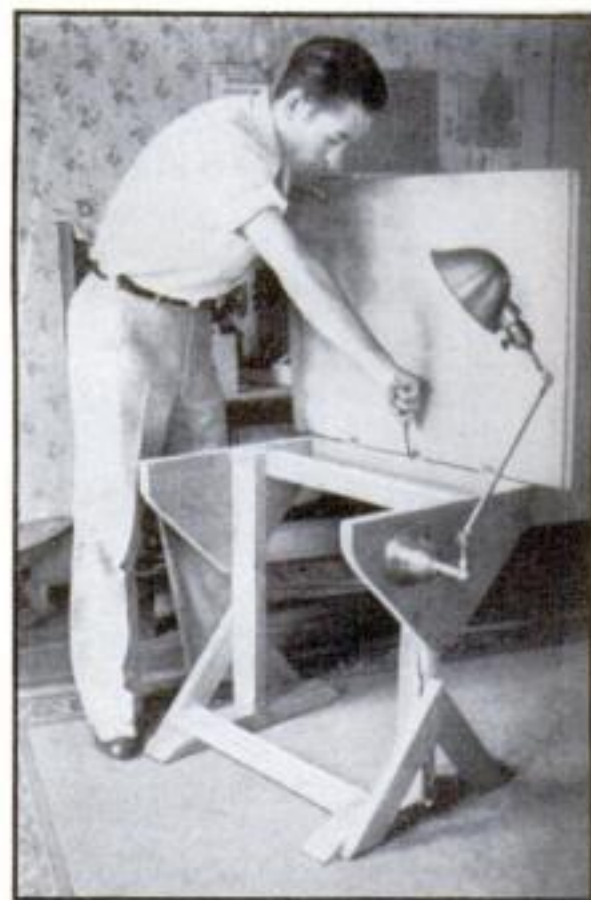


Light as it is, this drafting table is strong, rigid, easily adjusted, and well illuminated

By Leslie M. Holbrook

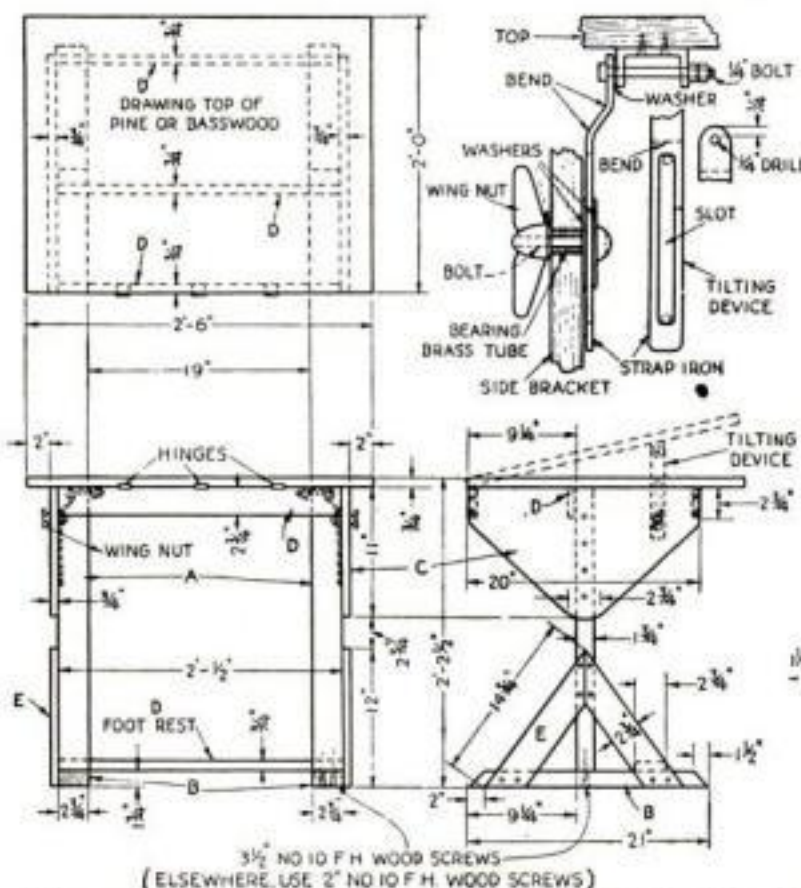
A HANDY all-purpose drafting table is a necessary part of the home craftsman's equipment. The table described here, although extremely light, is rigid and strong and requires a minimum of space.

For the top you may use an ordinary drawing board of pine or basswood, or make one from sugar pine as shown. The stand is also constructed of sugar pine. To assemble the end frames, fasten foot B to the leg A with $3\frac{1}{2}$ -in. No. 10 wood screws and glue. Then select two of the diagonal braces E and fasten them as shown in the side elevation. Side bracket C should be cut as suggested in the same view unless you desire to mount a cabinet on the stand for supplies; in that case the ends may be left straight. Fasten C to



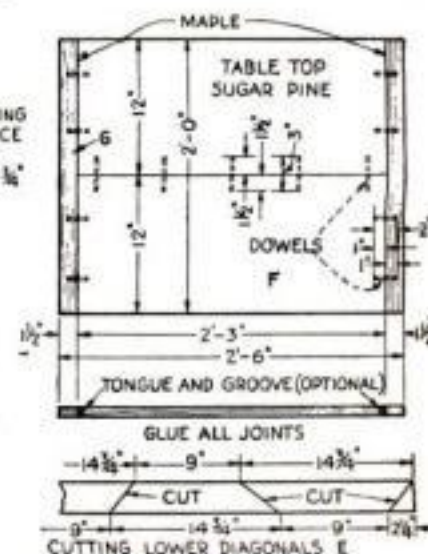
The top is attached to the framework with three brass hinges. Note the lamp bracket

leg A with glue and four wood screws. Then assemble all with crosspieces D and add the foot rest where most comfortable.



LIST OF MATERIALS

NO.	PART	T. W. L.	MATERIAL
2	LEGS A	$1\frac{1}{2}$ x $2\frac{1}{2}$ x 20	SUGAR PINE
2	FEET B	$1\frac{1}{2}$ x $2\frac{1}{2}$ x 20	"
2	SIDE BRACKETS C	$1\frac{1}{2}$ x $1\frac{1}{2}$ x 20	"
4	CROSSPIECES AND FOOT REST D	$1\frac{1}{2}$ x $2\frac{1}{2}$ x 20	"
4	DIAGONAL BRACES E	$1\frac{1}{2}$ x $2\frac{1}{2}$ x 18	"
2	DRAWING SURFACE F	$1\frac{1}{2}$ x $12\frac{1}{2}$ x 5	"
2	STIFFENERS G	$1\frac{1}{2}$ x $10\frac{1}{2}$ x 20	MAPLE



Top, front, and end views, and details of the top, the braces E, and the tilting device

ACCIDENTS PRODUCE GREAT INVENTIONS

(Continued from page 41)

discovered the secret of developing tintypes. It was in the course of an experiment that Becquerel put a quantity of uranium and a photographic plate together in a drawer, and so opened the way to the tremendously important investigations of the radiation of uranium.

ANTHRACITE as a fuel, or rather, the fact that anthracite will burn if given time to fire up, was discovered by a man who was experimenting with hard coal. He was about to give it up for a bad job when, one day, in the midst of a test, he was called to dinner and forgot to extinguish the flame of the kindling. Like Mason, the grainless-board man, he received the surprise of his life when he returned and found a hot bed of coals! Even the nameless medieval German monk, who, in his innocence, unleashed the fury of gunpowder upon the world and unwittingly changed the entire course of history, did so when he mixed charcoal, sulphur, and saltpeter in a mortar while conducting some obscure alchemistic experiment.

But there is another type of chance invention—the purely accidental kind. This, of course, occurs much more rarely and, like lightning, may strike anywhere. Such a discovery may result from a flash of insight by an intelligent person observing a natural phenomenon or a situation in the world about him; or it may be made just by dumb luck or even through a mistake.

An error on the part of a workman at the Centennial Exposition in Philadelphia in 1876, was responsible for one of the most important and far-reaching discoveries ever made. The man had been told to provide extra electric current for a circuit by starting two dynamos and turning the current from both on to the circuit. Forgetting the proper procedure, he connected both dynamos to the circuit and then started the engine driving the first dynamo. Instantly, the other dynamo started backward, running as an electric motor—the world's first electric motor capable of doing work!

Unfortunately for that workman and his descendants, he either never tried to patent his electric motor or perhaps employed an incompetent patent attorney who failed to secure for him the kind of patent that would have been worth millions of dollars.

It was a chance conversation with one of his master's patients that put Edward Jenner on the track of his epoch-making discovery of smallpox vaccination. At the time, about 1770, Jenner was articled, that is, apprenticed, to a surgeon at Sudbury, near Bristol, England. One day, a young countrywoman came for some cough medicine. While chatting with her, Jenner casually mentioned smallpox, and the girl remarked that she could not get it because she had had cowpox which made her immune.

In this accidental manner, Jenner learned of a popular notion in the district to the effect that milkers infected by a peculiar eruption that sometimes occurs on the cow's udder, were immune from smallpox. Medical men whom Jenner consulted dismissed the idea as a superstition, but the apprentice surgeon had a mind of his own. He then and there began the series of sensational experiments that led to his great discovery.

HAPPILY it is not necessary to go back to the eighteenth century to find examples of discoveries made by pure chance. A brand-new invention that may revolutionize automobile night-driving, resulted from a chance observation by a keen-witted acquaintance of mine. Walking along the main street of his small native city one

evening not long ago, he was amazed to notice that the dazzling glare of a street light disappeared when he passed a certain spot and reappeared a few feet beyond. He retraced his steps, and the same thing happened. His first thought was that some rope or rod might intercept the glare, but careful inspection failed to reveal any such obstacle protruding between him and the source of the light.

THE spot where this curious phenomenon occurred was in front of a brightly lighted drugstore with two show windows. Despite unconcealed curiosity on the part of a group of townsfolk waiting for a streetcar at that point, my friend again walked back and this is what he found:

When he stood in the red light shining from one of the drugstore windows, the glare of the street lamp was almost unbearable. When he stood in the green light shining from the other window, the glare disappeared.

Continuing his walk, he deliberately looked for an automobile parked at a drugstore. Naturally, he was not long finding one. He tested the effect on his eyes of the glare of its headlight, first by the red and then by the green light of the store. He was satisfied. By the red light, the glare was almost insufferable, but disappeared when the green light shone across his line of vision. The next few months my friend devoted to applying his discovery to a practical invention. His patent has been applied for, and is expected to be issued soon.

It is the fashion nowadays, as I observed at the beginning of this article, to belittle the element of chance in invention. One way in which this attitude is expressed, is in the debunking of stories about famous accidental discoveries, in which the men of my generation believed implicitly when they were boys.

These stories, we now are told, are merely legends, belonging in the same class as the anecdote of George Washington and the cherry tree. All right. But even so, chance always has played and always will play an important and thrilling part in the life of the inventor, and lends it a glamour no other element could supply. If ever you doubted this, you never will again after reading how Senfelder discovered the process of lithography. Here it is—not a legend or an old wives' tale, but the undisputed story of this remarkable discovery as told in the inventor's own words:

"I had just succeeded in polishing a stone plate which I intended to cover with etching ground, in order to continue my exercises in writing backwards, when my mother entered the room and desired me to write her a bill for the washerwoman, who was waiting for the linen. I happened not to have the smallest slip of paper at hand as my little stock of paper had been entirely exhausted by taking proof impressions from the stones; nor was there even a drop of ink in the inkstand.

"AS THE matter would not admit of delay, and we had nobody in the house to send for a supply of the deficient materials, I resolved to write the list with my ink prepared with wax, soap, and lamp-black, on the stone which had just been polished, and from which I could copy it at leisure.

"Some time after this, I was just going to wipe this writing from the stone, when the idea all at once struck me to try what would be the effect of such a writing with my prepared ink if I were to bite in the stone with aquafortis; and, having bitten away to about the hundredth part of an inch, I found that I could charge the lines with printing ink, and take successive impressions."

Protect Your Ideas by PATENTS

Little Ideas May Have BIG Commercial Possibilities

FREE BOOK

explains exactly what steps an inventor should take to secure a Patent on his invention. Many a man has conceived a valuable invention, but because he failed to patent it, has seen a later and more diligent inventor make a fortune out of the same idea.

Simple Ideas are Frequently Valuable

Your invention need not be big or revolutionary. Patents which sometimes prove to be the most profitable to the inventor are those granted for simple improvements on devices already in use. The history of invention is full of such successes.

35 Years Service to Inventors

Since 1898 we have specialized in Patents, and have successfully represented thousands of clients in all parts of the world. You are assured of prompt, skilled service at reasonable cost. Send today for our Free Book "How to Obtain a Patent" and our "Record of Invention" Blank. No charge or obligation. Use coupon below.

MAIL THIS TODAY

VICTOR J. EVANS & CO.
Established 1898
REGISTERED PATENT ATTORNEYS

VICTOR J. EVANS & CO.

MAIN OFFICE: 646-M Victor Building
WASHINGTON, D. C.

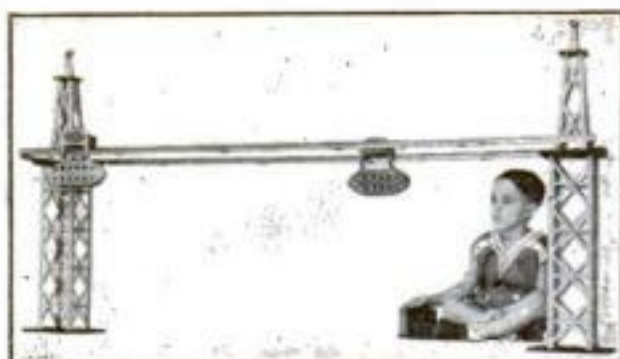
OTHER OFFICES: 1640 Conway Building, Chicago; 1007
Woolworth Building, New York; 828 Fidelity Philadelphia Trust
Building, Philadelphia; 514 Empire Building, Pittsburgh;
1010 Hobart Building, San Francisco.

Please send me your free book, "How to Obtain a Patent,"
and your free "Record of Invention Blank."

Name.....

Address.....

City.....State.....



BEAUTIFUL ELECTRIC SKY RIDES

The model C SKY RIDE \$7.95
Includes two towers 25" high, one illuminated car with automatic controlled motor to stop and start car at towers, two 32" rails to make span of 64" between towers. Beautifully finished in attractive enamel colors.

The model B SKY RIDE \$14.50
Same as above with two cars, each motorized with automatic control and remote control for each car. Four sections 32" rail to make double span between towers of 64".

The model A SKY RIDE \$19.75
This is the model pictured with searchlights atop the towers. The towers are 32" high. The cars are finished in aluminum and have automatic control to stop and start them at towers. The cars are illuminated and a remote control switch is included to control the cars by hand.

All sets operate on 6-8 V. A.C. or D.C. current. Extra 32" sections rail to increase span between towers to 96" or 128". Rail \$1.00 per section. We make a complete line of monorail toy railways as pictured at right. Priced at \$8.85, \$12.50, \$20.00 and up.

For complete descriptive literature send ten cents in coin to:

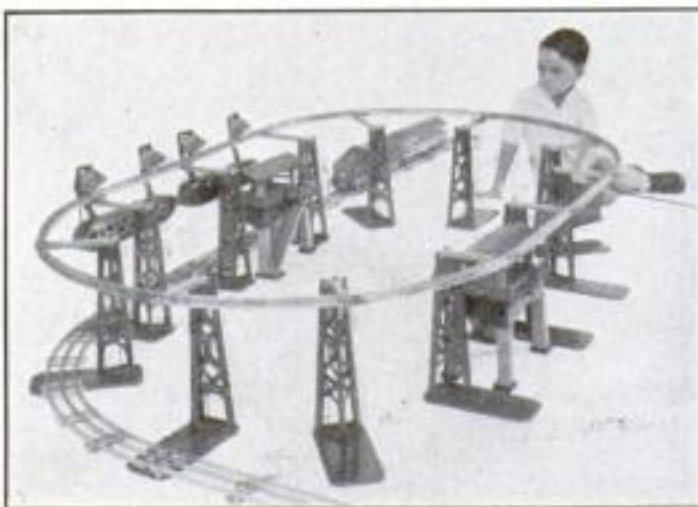
**Aero Monorail Company, Dept. S 2,
2712 Big Bend Blvd., Saint Louis, Mo.**

ORDER NOW



The finest toy power motor on earth. 6-8 volt. A.C. or D.C. geared reduction (cut tooth gears) to 2" grooved pulley, 8 to 1 or 16 to 1 reduction, as you wish. Reverse control switch. Size 9" x 3" x 2 1/2" high \$1.98

Extra pulley with 3/16" hole15
Endless 5/32" cord, rubber belt15



SHOP-KING

A RUGGED, man-size, complete machine that actually costs less than an outfit of small, light machines. Husky band saw, circular saw, disc jointer, lathe with 12" swing. One motor with 6-speed quick-shift belt does all jobs. Write today for literature to **SHOP-KING DIVISION, Outboard Motors Corporation, 1281 W. Ruby Ave., Milwaukee.**

DESIGNED BY OLE EVINRUDE

For Both Wood & Metal Working

BUILD A MODEL POWER BOAT

PLANS for constructing above 18" CRUISER Model with display of power plants 35c
PLANS for a 15" "V" Bottom SPEEDBOAT with display of power plants 25c
METAL BOAT PLANS 50c
DISPLAY sheet of power plants only (Spring and Electric motors) 5c

Send Coin or Stamps
SEATTLE MODEL BOAT CO., Seattle, Wash.
Dept. B., P. O. Box 333

NOW—A Slide Rule for 50c



Six inches long in genuine leather case with instruction booklet. Celluloid rule in metal frame—will not warp—constant friction. Special introductory offer to Popular Science Readers—Send Money Order for 50c to receive by return mail an indestructible slide rule at one fifth ordinary cost!!

INDECO 239 John Street, Bridgeport, Conn.

If you like **POPULAR SCIENCE MONTHLY** why not pass the word along to your friends. When an article in this magazine strikes you as being unusually good, tell your friends to get a copy at the newsstand, and read it.

U. S. Government Jobs RAILWAY POSTAL CLERKS MAIL CARRIERS

(City and Rural)

\$1700 to \$3400 Year—

MEN—BOYS, 17 UP SHOULD MAIL COUPON IMMEDIATELY



FRANKLIN INSTITUTE
Dept. S276, Rochester, N. Y.

Size: Rush to me WITHOUT CHARGE FREE 32-page Book with list of U. S. Government positions and full particulars telling how to get a steady U. S. Government position.

Name
Address

ELECTRICITY

GET THIS 96-PAGE BOOK

BOYS—and grown-ups, too—will find "Fun with Dry Batteries" a most instructive and entertaining little book. Make electro-magnets, bells, buzzers, signals, lights, secret locks, electro-plating outfits, telegraph instruments, and numerous amusing electric toys. Has simple, illustrated description of principles of electricity—and of dry batteries in particular. Sent post-paid for only 10c, coin or stamps. National Carbon Co., Inc., Dept. PSM, New York.



100 Shot Repeater HAENEL AIR PISTOL

For target practice, small game, rats, etc. Young men or grown-ups will find these ideal. Well made, strong, powerful, easy loading: heavy metal, wood stocks. 7" overall; wt. 1 lb. \$2 Deposit on C. O. D. 500 steel BB's and Leather Holster FREE (good to Dec. 10th. Clip this adv.). \$4.95 Single Shot—Keenfire 200 BB's, Darts, Targets Free \$2.45 Catalog—Pistols, Rifles, Binoculars, Microscopes, Telescopes Send Stamp. **P. LEE SALES CO., 35 W. 32nd St., New York**



DOCTORS FACE DEATH TRAILING POISONS

(Continued from page 15)

surrounding envelope that aids them to adhere and form nests of colonies which in certain stages are visible under the microscope.

Another fascinating drama of courageous research is connected with the name of Rocky Mountain spotted fever.

The work of fighting this disease was largely carried on by Dr. R. R. Spencer, of the United States Public Health Service. For a long period of time he worked with the disease daily, handling germ cultures so deadly they claimed the lives of four laboratory workers. Tedious and baffling were the experiments, for the germ eluded discovery; but at length Dr. Spencer succeeded in developing a vaccine with which he was able to immunize guinea pigs and monkeys.

Now he was ready to try it upon a human subject. Making a culture from ground-up infected wood ticks, he inoculated himself by taking the virus directly into his own blood. Then, as the disease began to make its appearance, he gave himself the protective vaccine.

The remedy proved its worth. Dr. Spencer recovered without serious consequence. Since then, more than 40,000 people have been protected by the vaccine.

To probe the riddle of the virus, the ultra-violet microscope is being used. Invisible rays of black light register upon photographic plates details too small to be seen otherwise. Two British experimenters recently thus succeeded in finding a previously invisible organism connected with the mysterious Borna disease, a sickness of horses.

It is known, however, that bacteria produce a mysterious chemical which rapidly spreads in body tissues to break down natural resistance against disease, paving the way for germs and their infection. Recently a synthetic chemical with similar properties has been produced at the Rockefeller Institute and given the imposing title of p-diazo-benzol-sulfonic acid. Injected into the skin, with a little India ink dissolved in it as a marker, the acid spreads with astonishing rapidity, covering as much as a square foot under the skin. Some such discovery may one day enable experimenters to penetrate the secret of the filterable virus.

ULTRA-SHORT-WAVE RADIO FOR AMATEURS

(Continued from page 59)

Considered in one way it has many advantages over the five-meter section. For besides its line-of-sight ground wave it also exhibits a Heaviside-layer wave that often turns up a great distances from the transmitter.

Although super-regenerative receivers also give the best results on ten meters, it is sometimes possible, providing the conditions are just right, to bring in the signals on an ordinary short-wave receiver equipped with a ten-meter coil.

Along this line, readers who have constructed the **POPULAR SCIENCE MONTHLY** short wave receiver (P. S. M., Apr. '32, p. 72) can try their luck with the ten meter band by temporarily altering their twenty-meter coil. The simplest way to do this is to tap the coil at the second or third turn to short out the remainder of the winding. This will cut the five turn coil down to approximately two and one half turns.

Plug the altered coil into your set. If the internal conditions in the set are just right, you will be able to listen in on some of the ten-meter activities and see for yourself how popular this band is becoming.

This One



YFE5-SAW-QT98

CHECKING UP ON TIME AND SEASONS

(Continued from page 39)

apart. When it is noon in New York, it is twelve minutes past noon in Boston. When it is noon in New York, it is twelve minutes before noon in Washington, D. C. In latitude forty degrees north, about twelve miles of east-west distance gives a difference of one minute of time. If every station along a transcontinental railroad should keep its own solar time, there would be endless confusion and danger in running trains.

STANDARD time solved the problem by adopting the local or solar time of each hourly meridian as the standard of a strip of land about 750 miles wide. The local time of the Philadelphia meridian became Eastern Standard Time; the solar time of St. Louis became Central Time; and so on. The time zones are not, however, bounded by straight north and south lines; the boundaries are more or less zig-zag, depending upon the presence of mountains and the end of railroad divisions.

The type of sundial which is the easiest to build, as well as the most nearly accurate, is shown in one of the illustrations. The lengths of the divisions on the semi-circular arc are all equal, from 6 A.M. to 6 P.M. The wire that casts the shadow should, of course, be placed at an angle with the ground equal to the latitude in which the dial is to be used. The wire will then be parallel to the earth's axis.

The principal reasons for the warmth of summer and the chill of winter can be made clear by a simple experiment. A globe

mounted upon an axis inclined twenty-three and one-half degrees to the vertical is turned so that it leans toward a flash light representing the sun. This indicates the earth's position at midsummer. When the square beam of light passing through a hole in a card falls upon the United States, it is concentrated upon a spot almost square. Its heating effect is therefore intense.

When the identical square beam is turned upon the United States with the earth's axis slanted away from the flash-light sun (its midwinter position) the light is spread out over a rectangle much larger in area than the square. The light is accordingly diffused over more ground and its heating effect is correspondingly lessened.

The illustrations giving top views of the earth in its summer and winter positions show additional reasons for the warm and cold seasons. In summer, with the earth's axis slanting toward the sun, the light and heat are received by a place in the northern hemisphere during the hours of a long day. The place gets a chance to cool off only during the short summer night. The opposite condition, of course, occurs during the short days and long nights of winter.

IN THE next article, a few common objects on a table will show us how star distances are measured; lumps of clay will illustrate how the moon was probably born from the earth; and a few books and two strips of tape will enable us to measure the moon's diameter.

COSTLY FUR FROM CHINCHILLA FARMS

(Continued from page 33)

nearby Molinos, on the western border of La Plata, one man exported 3,000 dozen pelts annually for years. But the trade had languished, for the chinchillas had gradually disappeared from that region.

"White men cannot travel into the country where the chinchillas live," Chapman told me, "When I first became interested in them, I sent out a couple of Indians to hunt them. Soon I had twenty-three Chilcans and Indians on the trail. Yet the net result of all that hunting was a dozen animals. I finally left South America with eleven animals; and arrived at Los Angeles with a dozen. An expectant mother had given birth to two while on the high seas and we managed to save one of them.

"MY CHINCHILLAS came from the highlands above Potrerillos in the province of de Altacama. I lived at an altitude of 11,300 feet but the trappers went a mile higher. Strange as it may sound to people unaccustomed to living in the wild, they actually caught several with their hands. The chinchilla is one of the most curious animals alive. Fire a gun and he runs into his hole; but a moment later you see his little head sticking out as he looks around the mountain.

"The hunters take advantage of this curiosity and often take a seat in front of a hole and wait for hours, hoping a chinchilla will make a personal appearance. Sometimes their patience was rewarded as a chinchilla would emerge slowly from his hole and crawl over the leg blocking his path. Then the trapper would grab and grab quick, for a chinchilla is as quick as a rabbit, though he can't run as fast."

Through a combination of circumstances, Chapman, who as a youth raised rabbits

and squirrels for their hides at Grants Pass, Ore., was set down where chinchillas were considered to be as abundant as anywhere on the continent. Meantime several expeditions had spent fortunes in a fruitless effort to catch and transplant several pair to the United States or to Europe.

Undismayed by the many failures of which he had heard, Chapman continued his search. At last, his runners brought him eleven grown animals. For two years he kept them at an altitude of 11,000 feet, studying their habits, watching over their health. Then he carried them down the mountain and stopped a year 8,000 feet above the sea. As the ice began to thaw after the third year, he loaded them in wire cages, strapped them on the backs of burros and completed the journey to the sea.

THE worst part of the long trip lay ahead, the sea voyage. He boarded a steamer from Iquique, Chile, with the little fellows panting for breath. Accustomed to thriving in freezing gales far below zero, they suddenly were catapulted into a summer heat none ever had experienced. For forty days and nights, Chapman kept them in virtual refrigerators—ice-chilled cages curtained with moist canvas. Yet they suffered so that many times during that trip he applied ice packs to their heads as various animals passed out in the heat.

"To complicate matters," Chapman commented wryly, as we squatted over one of his finest pairs at his Inglewood, Calif., ranch, "when only four days out from California they shed their fur and we had to wrap the whole batch in blankets to keep them from freezing. At last, after what seemed an eternity, we landed a dozen under permit of the U. S. Biological Survey, the first, and last, to reach the United States alive."

Send No Money GUARANTEED UNDERWOOD

Regular \$100.00 Model

Only \$39.90 Cash

On Easy Terms.

10 Day Trial No Money Down



Positively the greatest bargain ever offered! A genuine late model Underwood No. 5, for only \$39.90 (cash) or on easy terms. Think of it, less than 1/2 the manufacturers' original price. Send for your 10-day Free Trial at once while this offer lasts. See for yourself, without risk. Every machine fully guaranteed.

Lowest Price and Easiest Terms full 10-Day Trial—then 10c a Day

This late model Underwood, at only \$39.90 (cash), is the lowest ever quoted. Has all modern improvements, including 4 row universal keyboard, two color ribbon, back spacer, ribbon reverse, tabulator, release, shift lock key, and many other improvements. Beautifully refinished and renewed. Looks and operates like new.

Learn Touch Typewriting
Complete Home Study Course of the Famous Van Sant Speed Typewriting System—fully illustrated, easily learned, given during this offer.

Money Back Guarantee

Send coupon for 10-day trial—if you decide to keep it pay only \$3.00 a month until \$44.90 (term price) is paid. Limited offer—act at once.

INTERNATIONAL TYPEWRITER EXCHANGE,
231 West Monroe St., Chicago, Ill., Dept. 1207

Send Underwood No. 5 (P. O. B., Chicago) at once for 10-day trial. If I am not perfectly satisfied I can return it express collect. If I keep it I will pay \$3.00 a month until I have paid \$44.90 (term price) in full.

Name.....Age.....

Address.....

Town.....State.....

QUICK Success • and what a Thrill!

For YOU! Quick success, and the big thrills of life, with a P-A Sax! Popularity! Soft job! Big pay! Many play tunes first week; join band or start your own dance orchestra in 3 months, with a free blowing, tone sure, P-A Sax, Trumpet, Trombone, or Clarinet. See your local P-A Dealer. Try an instrument. Ask about the new features, moderate prices, easy terms. Or write to us for free booklet. No obligation. Get started now.

PAN-AMERICAN 1204 Pan-American Bldg.
ELKHART, INDIANA 1093

Moderate Price

SHOW CARD LETTERING

HERE is the very course you need if you seek a position as a Show Card Letterer or Sign Letterer, or want to have a business of your own. Complete and practical and especially arranged to meet the needs of the student who studies at home. Written by E. L. Koller, Principal of the International School of Art, member of the American Federation of Arts, and The National Society of Craftsmen. Mail coupon for Free Booklet.

INTERNATIONAL SCHOOL OF ART
Division of the
International Correspondence Schools
Box 7664-G, Scranton, Penna.

Without cost or obligation, please send me full details of your home-study course in

☐ Show Card Lettering

☐ Illustrating ☐ Cartooning

Name.....

Address.....

How a Veteran Pilot Flies Down Radio Beam

(Continued from page 36)

nor dangerous now. Our position is known every second as definitely as though the ship were standing alongside the runway. All I did was swing the plane into a bank and circle downward to the left. That way I would be on the low side when at last we broke from the fog.

From here to the bottom, the story belongs to Ables.

"YOU just passed the administration building," said the voice, hidden down there beneath the heavy canopy of moisture. "You are now east of the field . . . you are northeast . . . north . . . northwest . . . over Wilson's airport . . . blimp your engines, Dick . . . cannot hear you."

I flew the ship in an easy circle, bearing always to the left. Occasionally the wind would carry the engines' sound away from the airport. Then it was Joe would ask me to speed up the motors. Six times I circled, as the song of the ground man poured incessantly into my ears. As he talked, he held two telephones to his ears. One was connected directly with me; the other with the operations office, where a radio operator stood vigil. In case Joe missed part of a message from me, he needed only to speak into the second phone to the operator, who also heard our conversation as it proceeded.

"South of field . . . southeast . . . east . . ."

I still could not see anything below when Joe's reassuring voice said: "You have good altitude and should see the field at 900."

Quick calculation told me my altimeter should read about 1,600 feet when at last I would break through the floor of the fog, for the airport itself lies 700 feet above the sea. The voice talked incessantly as I wound around the field. At last, three minutes after we first plunged in, he said:

"I can see you Dick. You are on the west edge of the field."

Confidence! Who could ask for more? There I was, blind; yet a man nearly a mile distant, standing securely on the ground was acting as my eyes. He directed every move, even when I was totally obscured; now he could see me, give me that reassurance on the threshold of the earth's reappearance to the passengers which they had seen last a hundred miles distant.

"Okay," I said distinctly into the mike when, a few seconds later the field lights burst into view. "What's the wind?"

Two minutes later I set the ship down into a seven-mile wind and the passengers disembarked little thinking that the resources of science had made possible for them a safe and uneventful flight that would have been impossible as recently as three years ago.

When the public comes to realize as do I, the wonders of radio and meteorology, they will marvel at the extraordinary advances that have taken place since I first began to fly mail planes along the Pacific Coast only six years ago. We think nothing now of taking off blind at midnight, pulling up through a heavy layer, and pounding ahead on schedule.

YET there is no chance in these operations. We are guided by fixed and inflexible rules. We know from many observations and reports of ground men, what to expect ahead.

For instance, I landed at Bakersfield not long ago, warned by radio, that the mountains were closed in by a severe storm. Above and as far south as the eye could see stars twinkled merrily and cast their pale light on the countryside. Yet down we sat.

One passenger protested.

"Young fellow," he expostulated, "any fool can see we've got good weather. You must be an amateur or you would carry us on to Los Angeles."

I explained politely that I had spent some 5,000 hours in flying over this route, that when the mountain stations reported impassable storms, those storms were impassable as far as I was concerned. After a three-hour delay, we flew over safely.

We always land at some intermediate field when the crackling radio warns of hazardous storms ahead, for a heavy responsibility rests on the pilot. From two points of view, safe performance means his bread and butter: his license and his job. After all, the number of transport pilots is small. Fewer than 650 fly for the airlines and our employers keep close tabs on us.

The passenger cannot understand why, one day, we will climb above fog and fly a long distance with the earth obliterated and, on another, will decline to take off under a blue sky. Yet the flight over the mountains that night would have been dangerous, whereas a few weeks later I flew fully an hour through dense fog to Oakland, safely following the beam.

We are required to train periodically "under the hood," taking off, navigating, and landing by instruments in order to be fully qualified to meet blind conditions. We do not call it blind flying now, for radio and instruments combined enable us to see

whether we fly 1,000 feet or 20,000 feet high, the din of the beam beats constantly on our ears.

The beam and accurate instruments got me through a storm safely one night. Shortly after I left Merced, with a half-hour to go to Oakland, I encountered bad weather. I started to pull up, hoping to fly above it, but the plane began to pick up ice at 5,000 feet. I nosed her down to 4,000, realizing this would be a safe altitude to escape the ice and to clear the Livermore hills ahead.

Then I tuned in the Oakland beam and set my course directly for the field. A half-hour passed, forty minutes, fifty. Still no Oakland. I realized I was flying into a head wind, since the storm was moving southward, and knew I had no cause to worry. Steadily the engine droned on and one hour after I had entered the stuff, the beam suddenly died. I was over the wide cone of silence. A voice from the ground then directed me down in a slow spiral and I landed. An hour later three-eighths of an inch of ice still clung to the wings.

Had it not been for the beam, I should never have attempted that flight with the night mail; yet it was far safer than many flights I made in the earlier days under more favorable conditions. Three years ago I would have turned back at Merced and set the mail down at Fresno, to be delivered by truck.

Sometimes we will not carry passengers even when the observers report fog at comparatively low altitudes on the north side of the Tehachapi, for we look beyond the formal reports into experience. Occasionally high pressures on the desert toward the east will draw air over the mountains, bringing the fog and clouds down in a torrent. One night, flying without passengers, I hit this wind. Soon I noticed the fog drifting forward under my wings, moving even faster than my speed, then 120 miles an hour.

Curious, I thought; almost unbelievable. To check the speed of the scurrying mass, I nosed the plane down, picking up a speed of 150 miles an hour. Still the fog outraced me. Not wishing to be thought silly, I checked the movement on two later occasions before reporting it. Then I learned other pilots had had the same experience.

The fog rushes to the desert, strikes the hot air, and becomes dissipated, disappearing suddenly in thin air. It is one of the oddest phenomena I have ever witnessed from an airplane at midnight!

Not infrequently the same meteorological conditions will cause the wind to behave similarly, though there are no clouds.

The great speed of our newer planes, fully fifty miles an hour faster than the ship in which I made the Merced-Oakland flight, will enable us to outrace sudden disturbances. Here, at last, are vehicles of the air that approach closely self-flying, though they are not yet equipped with robot pilots. Twenty-one instruments and thirteen controls, all operated from the cockpit.

Landing lights, set permanently within the wings, cast brilliant rays through thick glass shields. Landing gear disappears within the wing during flight. Under the nose of the plane is an electrically-heated pitot tube by means of which air speed is measured. No ice will collect here to prevent proper functioning. By adjusting flaps fixed to the trailing edges of wings, rudder, and flippers we can trim the plane in flight to hold up a heavy wing, set our course in a cross wind, or hold the plane level with varying passenger loads.

And speed! For the first time passenger planes find their cruising speed jumped up suddenly nearly fifty miles an hour. A new era for scheduled flying has arrived.

Good News for HOBBYISTS

An announcement of importance to all those who have home workshops or pursue any branch of the manual arts for amusement, is published on pages 62 and 63 of this issue.

POPULAR SCIENCE MONTHLY has offered its name and its prestige to the great movement described on these pages and it is the earnest and confident hope of the publishers that the readers of this magazine will take a leading part in effecting the successful organization of the projected national association of amateur craftsmen.

very well. Every transport pilot is fully qualified to maneuver safely by instruments.

We older pilots have been flying by instrument for years. I long ago quit worrying about flying with one wing low. If the compass should swing off five degrees, indicating I had turned a little off course, I knew it soon would swing back again. Nature has a way of compensating for these errors.

But today the Department of Commerce inspector who checked me for instrument flying spoke frequently through the voice tubes, warning me to keep the ship in level flight. Nor do aerobatics have any place in transport flying. We keep the ship level always, under all conditions.

We used to fly by the "seat of our pants." Now in flying the beam, we must pay close attention to the position of the ship, for the beam is narrow. Two miles from the station, it measures only 100 feet in width and is only seven miles wide a hundred miles distant.

Sometimes the beam shifts and weaves, particularly at sunrise and sunset. Yet it leads inevitably to its source. No matter

I saved 1/2 by buying direct from the Midwest Laboratories

Yes, and it gives you WORLD-WIDE Reception!

Amazing New
SUPER Deluxe

16-TUBE ALL-WAVE Radio

9 TO 2,000 METERS



New
FREE CATALOG
WRITE TODAY!

**30 DAYS
FREE TRIAL**

THOUSANDS of satisfied customers have saved from 1/3 to 1/2 on their radios by buying direct from Midwest Laboratories. You, too, can make a positive saving of 30% to 50% by buying this 16-tube DeLuxe ALL-WAVE radio... finest development of Midwest's 14 years experience as leading radio manufacturer... at the sensationally low direct-from-laboratory price of only \$49.50. You'll be amazed and delighted at its super performance! It brings in broadcasts from stations 10,000 miles and more away. Gives complete wave length coverage of 9 to 2,000 meters (33 megacycles to 150 KC). Send for the big FREE catalog today! This bigger, better, more powerful, clearer-toned, super-selective radio has FIVE distinct wave bands: ultra short, short, medium, broadcast and long... putting whole world of radio at your finger tips. Now listen in on all U. S. programs... Canadian, police, amateur, commercial, airplane and ship broadcasts... and world's finest stations as: DFA, Nauen, Germany—REN, Moscow, Russia—EAQ, Madrid, Spain—12RO, Rome, Italy—VK2ME, Sydney, Australia. Never before so much radio for so little money. Don't buy any radio until you learn about this greatest of radio values. Send today for money-saving facts!

40 NEW 1934 FEATURES

Try this Midwest radio... in your own home... for thirty days before you decide. See for yourself the 40 new 1934 features that insure amazing performance. For example—Automatic SELECT-O-BAND (exclusive with Midwest), simplifies short wave tuning, instantly pointing out wave length of the station.

Other features include: Amplified Automatic Volume Control, 16 New Type Tubes, Balanced Unit Superheterodyne Circuit, Velvety Action Tuning, Super Power Class "A" Amplifier, 29 Tuned Circuits, New Duplex-Diode-High Mu Pentode Tubes, No-Image Heterodynes, Full Rubber Floated Chassis, Variable Tone Blender, Centralized Tuning, 7 KC Selectivity, New Thermionic Rectifier, Totally Scientifically Shielded (coils and switch catacombed), etc. These and many additional features are usually found only in sets selling from \$100 to \$150.

WONDERFUL FOREIGN RECEPTION

NEWBERRY, S. C.—My Midwest 16 is the finest radio I ever heard. I have tuned in "everything" in United States, Canada and Mexico. Have picked up stations in South America, England, France, Spain, Germany, Italy. Also airplane and ship transmitters, police stations, and numerous "ham" phone and code transmitters.

WILBUR LONG, JR.,
746 Pope St.

TERMS

AS LOW AS
\$5.00 DOWN

DEAL DIRECT WITH LABORATORIES

Increasing costs are sure to result in higher radio prices soon. Buy before the big advance... NOW, while you can take advantage of Midwest's amazingly low prices. No middlemen's profits to pay! You save from 30% to 50% when you buy direct from Midwest Laboratories... you get 30 days FREE trial—as little as \$5.00 down puts a Midwest radio in your home. Satisfaction guaranteed or your money back! FREE catalog shows sensational radio values. Write TODAY!

**SAVE
UP TO 50%**

**WORLD'S GREATEST
RADIO VALUE**

\$49.50

with New
**Deluxe Auditorium Type
SPEAKER**

BIG FREE CATALOG

The 24-page catalog shown above pictures the performance curves of this super radio. It illustrates a complete line of beautiful, artistic, de luxe consoles... in the new modernistic designs... priced to save you 30% to 50%. You can order your Midwest radio by mail with as much certainty of satisfaction as if you were to select it personally at our great radio laboratories. Write for your FREE catalog NOW!



**RUSH THIS COUPON FOR
AMAZING 30-DAY FREE TRIAL
OFFER AND NEW 1934 CATALOG**

MIDWEST RADIO CORP.,
Dept. 298,
Cincinnati, Ohio.

Without obligation on my part send me your new FREE 1934 catalog, and complete details of your liberal 30-day FREE trial offer. This is NOT an order.

**AGENTS!
Make Easy
Extra Money**
Check Here
for Details ☐

Name.....
Address.....
City..... State.....

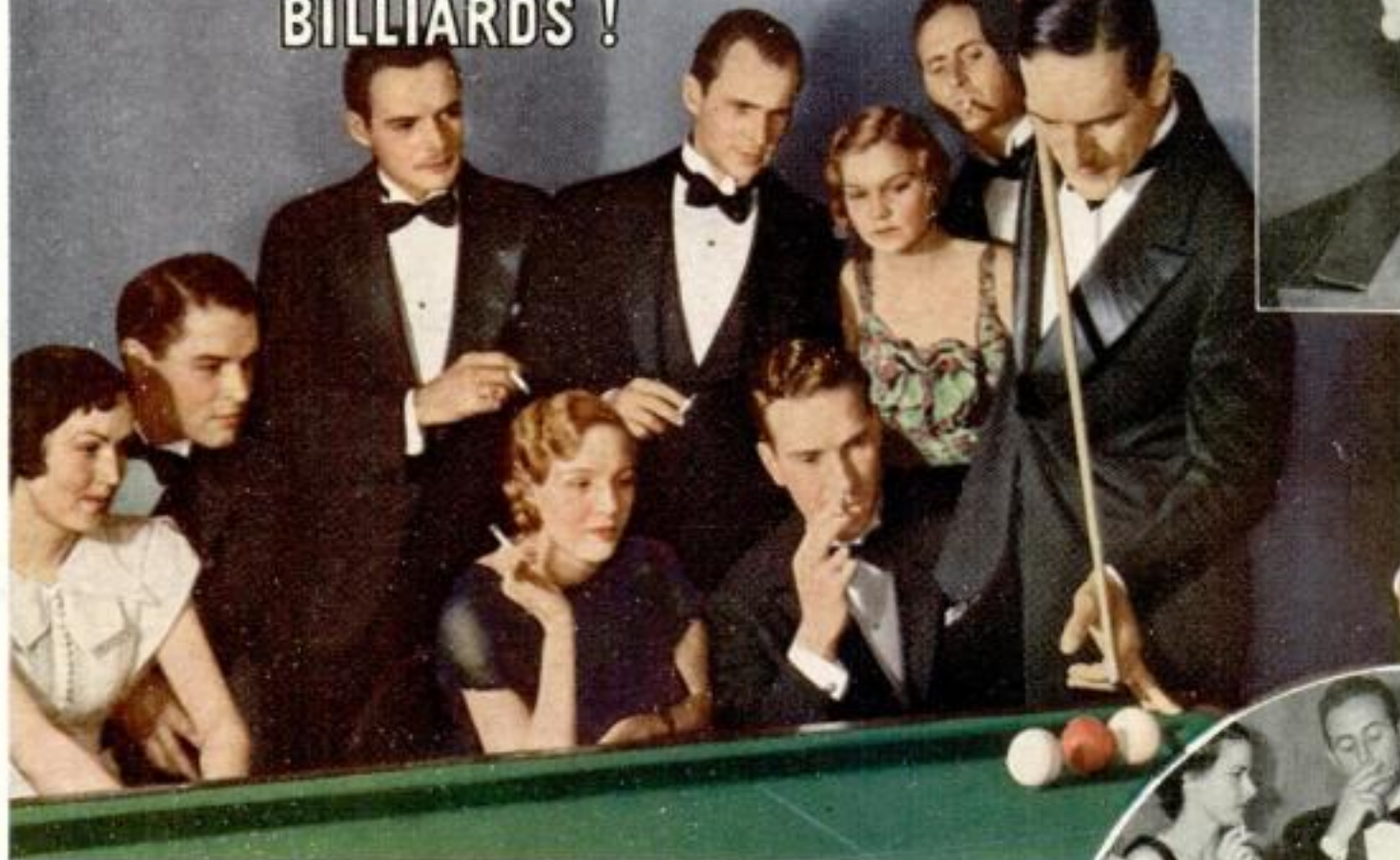
MIDWEST RADIO CORP.

DEPT. 298—CINCINNATI, OHIO, U. S. A.

Established 1920

Cable Address Miraco. ABC 5th Edition

IT TAKES HEALTHY NERVES TO RUN 308 AT BILLIARDS!



● MR. HAGENLOCHER says, "If I were giving one simple rule for successful billiard play, I should say, 'Watch your nerves!' That's why I've smoked Camels for years. They never upset my nervous system."

● ERICH HAGENLOCHER, twice 18.2 ball-line billiard champion of the world. Healthy nerves have carried him successfully through the sternest international competition to many titles.

● RIGHT—TALKING IT OVER calls for more Camels. Steady smoking reveals the true quality of a cigarette. Camels keep right on tasting mild, rich and cool... no matter how many you smoke.

Steady Smokers turn to Camels

"I know of no sport," says Erich Hagenlocher, "that places a greater strain on the nerves than tournament billiards. The slightest inaccuracy can ruin an important run. One simple rule for success is, 'Watch your nerves!' I have smoked Camels for years. I like their taste better and because they're milder, they never upset my nervous system."

There is a difference between Camel's costlier tobaccos and the tobaccos used in other popular cigarettes. You'll notice the difference in taste and in mildness—and Camels *never* jangle your nerves. You can prove this yourself. Begin today!



IT IS MORE FUN TO KNOW

Camels are made from finer, MORE EXPENSIVE tobaccos than any other popular brand. They give more pleasure. Your own taste will confirm this.

Camel's Costlier Tobaccos

NEVER GET ON YOUR NERVES
NEVER TIRE YOUR TASTE

Copyright, 1933,
R. J. Reynolds Tobacco Company